The King's Sanatorium

PREFACE.

I AM commanded by HIS MAJESTY KING EDWARD VII. to preface the publication of the Essays and Plans which were successful in the recent competition for the Erection of a Sanatorium for Tuberculosis by a brief explanation of the principles by which His Majesty's Advisory Committee was guided in the adjudication of the Prizes. It will be well, therefore, to reproduce the terms of the Advertisement announcing the Competition, which was issued in the medical papers in the first week of January, 1902:—

PRIZE ESSAY FOR THE ERECTION OF A SANATORIUM IN ENGLAND FOR TUBERCULOSIS.

HIS MAJESTY THE KING has graciously consented to direct that the Expenditure of a large sum of money which has been placed at his disposal for charitable or utilitarian purposes shall be devoted to the Erection in England of a Sanatorium for Tuberculous Patients.

His Majesty has appointed the following Gentlemen as an Advisory Committee for this purpose: SIR WILLIAM BROADBENT, Bart., K.C.V.O.; SIR RICHARD DOUGLAS POWELL, Bart., K.C.V.O.; SIR FRANCIS LAKING, K.C.V.O.; SIR FELIX SEMON; SIR HERMANN WEBER; DR. C. THEODORE WILLIAMS.

It is intended to construct the Sanatorium on the best lines which past experience and original thought can suggest, and in order to obtain the most valuable opinions His Majesty has been pleased to approve that a sum of £800 be awarded in Prizes for the best Essays and Plans which may be sent in to the Advisory Committee, under the following conditions:—

1. Medical Men of all nationalities may compete. The Papers may either be the work of a Medical Man or the joint production of a Medical Man and an Architect.

2. The Sanatorium is intended for 100 Tuberculous Patients—50 male and 50 female.

3. Of the total number of beds, 88 will be assigned to the more necessitous classes, whilst 12 will be reserved for the well-to-do.

4. The accommodation for all patients is to be comfortable, a separate room being provided for each. Superior arrangements to be made for the more wealthy patients.

5. It may be taken for granted that the Sanatorium will be erected on an elevated and sloping site, with a sunny exposure, and well sheltered from cold winds. It will have a Farm at a convenient distance and be surrounded by extensive grounds, well-wooded, and affording ample space for exercises of various kinds. The soil will be dry and permeable and the water supply abundant.

6. The Sanatorium must be fitted with the latest sanitary arrangements and equipped with all requirements for scientific research. Provision should also be made for the recreation of the patients.

7. Economy in construction will be an important consideration, but it must not interfere with the reasonable comfort of the patients or the efficiency of the Institution.

8. The Essays must be in English and type-written.

9. The Essays must not bear the name or names of their Authors, but should have a Motto, and each Essay should be accompanied by a sealed envelope bearing the Motto on the outside and containing the full name and address of the Author or Authors inside.

10. All Essays and Plans must be sent, postage paid, on or before the 15th April, 1902, to one of the Secretaries of the Committee:

Dr. P. HORTON-SMITH, 15, Upper Brook Street, W. London; or
Dr. J. BROADBENT, 35, Seymour Street, W. London.

11. Three Money Prizes of £500, £200, and £100 respectively will be awarded, in order of merit, on the recommendation of the Advisory Committee, for the three best Essays, provided they come up to the requisite standard of excellence. Brevity will be an important consideration, and a summary of the main features of the scheme should be appended to the Paper. Unsuccessful Papers will be returned to the Authors.

This Advertisement appeared in 22 medical papers in the Capitals of Europe and America.

The object of the Competition was to obtain information as to the relative advantages of the various structural arrangements which have been employed in existing Sanatoriums, and to elicit new ideas which might be turned to advantage in the construction of the "King Edward VII. Sanatorium" so as to make it as perfect as possible. The Essays were adjudicated according as they conformed in greater or lesser degree to these requirements. The number of Essays sent in was 180. They were carefully read and were grouped into three classes, "α," "β," and "γ." Those in Class "γ" were first eliminated, then those in Class "β," Class "α" alone being retained. By a further process of selection the latter were narrowed down to twelve, from among which, by a unanimous vote of the Advisory Committee, the three Prize-winners were finally chosen.

Immediately after the decision had been arrived at, the sealed envelopes containing the names of the authors, and bearing on the outside their mottoes, were opened by the Secretaries in the presence of the Committee, and the names and nationality of the writers thus disclosed.

The following is the list of the Prize-winners and of four other competitors to whom Honourable Mention was awarded, the latter being placed in alphabetical order:—

FIRST PRIZE: MOTTO: "Give him air; he'll straight be well."
DR. ARTHUR LATHAM (London), *with whom was associated as Architect* MR. WILLIAM WEST (London).

SECOND PRIZE: MOTTO: "If preventable, why not prevented?"
DR. F. J. WETHERED (London), *with whom were associated as Architects* MESSRS. LAW AND ALLEN (London).

THIRD PRIZE: MOTTO: "Vis medicatrix naturæ."
DR. E. C. MORLAND (Croydon), *with whom was associated as Architect* MR. G. MORLAND (Croydon).

HONOURABLY MENTIONED:

(*a*) "Fac Recte, nil time." DR. P. S. HICHENS (Northampton), *with whom was associated as Architect* MR. R. W. SCHULTZ (London).

(*b*) "Open air everywhere." DR. TURBAN (Davos), *with whom was associated as Architect* HERR J. GROS (Zürich).

(*c*) "Doncsta quam magna." DR. JANE WALKER (London), *with whom were associated as Architects* MESSRS. SMITH AND BREWER (London).

(*d*) "Humus." DR. J. P. WILLS (Bexhill), *with whom was associated as Architect* MR. WILLS (London).

With the approval of His Majesty the result of the Competition was announced in the medical papers on August 8th, 1902.

(Signed) W. H. Broadbent M.D. M.Ch.

Chairman of His Majesty's Advisory Committee.

The King's Sanatorium

THE THREE PRIZE ESSAYS

ESSAY ON

THE ERECTION OF A SANATORIUM FOR THE TREATMENT OF TUBERCULOSIS IN ENGLAND:

TOGETHER WITH A NUMBER OF APPENDICES AND ILLUSTRATIVE PLANS.

BY ARTHUR LATHAM, M.A., M.D. OXON., M.A. CANTAB.,

ASSISTANT PHYSICIAN AND LECTURER ON PRACTICAL MEDICINE AT ST. GEORGE'S HOSPITAL; ASSISTANT PHYSICIAN AT THE BROMPTON HOSPITAL FOR CONSUMPTION AND DISEASES OF THE CHEST; FORMERLY RADCLIFFE TRAVELLING FELLOW IN THE UNIVERSITY OF OXFORD; RESEARCH SCHOLAR OF THE HONOURABLE GROCERS' COMPANY; AND PHYSICIAN TO OUT-PATIENTS, VICTORIA HOSPITAL FOR CHILDREN.

With whom is associated as Architect A. WILLIAM WEST, *Deputy Treasurer of St. George's Hospital.*

PART I.

HISTORICAL INTRODUCTION.

TWENTY-FIVE centuries ago Hippocrates wrote that tuberculosis was a curable affection provided that it was treated at a sufficiently early stage. Many of the ancient authors, such as Celsus, Pliny, Galen, and others, expressed similar opinions and insisted on the importance of a suitable climate and good living. It was left, however, to a Scotch physician in 1747, when writing to his London friends, to assert for the first time in clear and unmistakeable language, supported by the incontestable evidence of the results he had obtained, that hygiene and diet are the most important factors in the treatment of tuberculosis and that climate and medicine are only to be considered as more or less precious adjuvants. The practical outcome of this teaching was not encouraging and until some 50 years ago both the public and the overwhelming majority of the medical profession regarded tuberculosis as an incurable disease. So much so was this the case that Sir T. Young, writing in 1815, said: "Even with the utmost powers of art perhaps not more than one case in 100 will be found curable," whilst Ullesperger called attention in 1867 to the fact that up to that time barely 200 cases of cured, or what we should now term arrested, tuberculosis were to be found in medical, as distinct from pathological, literature. A French writer took a more hopeful view when he said, "There are two kinds of consumption, that of the rich, which is sometimes, and that of the poor, which is never, cured." The principles announced by the Scotch physician were not readily appreciated and were seldom put into practice, the efforts of medical men of that day being directed towards the comfort of their patients rather than the arrest of the disease. Thus every tuberculous individual, and even those who were regarded as being likely to contract the disorder, were wrapped up in heavy clothes, kept in a hot house atmosphere, and jealously guarded against exposure to the fresh air.

The great additions to our knowledge on the pathology of tuberculosis which originated in the genius of Laennec paved the way for the radical alteration of the views held by the majority of physicians with regard to the curability and treatment of the disease which was chiefly brought about by the teaching of Carswell. In 1836 this author wrote: "Pathological anatomy has never afforded stronger evidence of the curability of a disease than in the case of phthisis." This opinion has been supported by every subsequent observer. That this view was able to gain ground as rapidly as it did was due in no small measure to the establishment in England of special hospitals for consumption—namely, the Royal Sea-bathing Infirmary for Scrofula at Margate in 1791, the Royal Hospital for Diseases of the Chest in London in 1814, and the Brompton Hospital for Consumption in 1841. Further progress towards a true conception of tuberculosis was made by Pasteur's creation of the new science of bacteriology, by Villemin's demonstration in 1865 of the fact that the disease can be transmitted to animals by means of inoculation, by Koch's announcement in 1882 of his memorable discovery that tuberculosis is an infective disease and depends for its inception upon a bacillus, and finally by Sir John Simon's classification in 1887 of tuberculosis as a filth disease.

The advance of our pathological knowledge during recent years has made it possible to formulate the real principles upon which the treatment of this disease should be based, but we owe a deep debt to those members of the medical profession who, from time to time during the last century, made an effort, in spite of the contumely poured upon them by their fellow practitioners, to carry out the treatment on the basis we now adopt. In 1840 George Bodington, of Sutton Coldfield, Warwickshire, England, wrote an essay on "The Cure of Pulmonary Consumption on Principles, Natural, Rational, and Successful," in which he insisted on the importance of a generous diet, fresh air day and night, "together with systematic arrangements with regard to exercise and general treatment, and the watchfulness daily—nay, almost hourly—over a patient of a medical superintendent." Bodington emphasised his views on the necessity of a continuous supply of fresh air by this sentence: "Cold is never too intense for a consumptive patient; the apartment should be kept well aired, so that it should resemble the pure air outside, pure air being used in the treatment as much as possible." This author met with the most bitter and contemptuous treatment, being regarded as a lunatic; his patients were driven from his institution, which by the irony of fate he was compelled to turn into an asylum for the reception of the insane. His sanatorium was the first of its kind in the world, and within its walls, for several years previous to the publication of his essay, Bodington had practised his principles and effected many cures. In 1855 Dr. Henry McCormac of Belfast published a book on somewhat similar lines, and as a result had to bear every kind of persecution to which a man in his position could be subjected. In 1861 he read before a distinguished medical society in London a paper on the Absolute Preventability of Consumption in which he advocated what are now established principles. Practically the same doctrine was preached at this time by Bennett of Mentone and by the late Sir Benjamin Ward Richardson who embodied his views in a pamphlet called "A Sanitary Decalogue." The man, however, who must be regarded as the founder of the sanatorium treatment of tuberculosis is Hermann Brehmer, for he persisted, in spite of fierce opposition and oftentimes abuse, with his methods, which were more systematic and thorough than those of his predecessors, and he finally convinced the world of their soundness and importance. Brehmer's thesis for his final degree (1856), "Tuberculosis primis in stadiis semper curabilis," was characteristic of his life's work; in 1859 he was permitted, owing to the influence of his friends Humbolt and Schönlein, to open a sanatorium at Görbersdorf, and in 1886 he published his well-known book.

General acceptance of Brehmer's views did not come at once; indeed, some of the grounds upon which they were based have since been shown to be erroneous. His supporters met with little encouragement and not infrequently with reproach, but it is owing to them, to such men as Rohden, Dettweiler, and Otto Walther in Germany, Sir Hermann Weber in England, and Blake and E. L. Trudeau in the United States of America, that we have at last come to regard the open-air sanatorium treatment as the best remedy for tuberculosis.

Brehmer's views.—Brehmer held that tuberculosis was an infectious disorder, but that certain conditions, more especially a small heart, made people much more liable to it. He noticed that at Görbersdorf there was hardly any tuberculous disease and that the inhabitants had peculiarly powerful hearts. These facts, he thought, were due to the air pressure at the altitude of that place. He not only adopted Küchenmeister's theory that tuberculous disease did not exist above a certain altitude which increased as the equator was approached, but supposed that the diminution of air-pressure increased the power of the heart and so lessened the liability towards tuberculous infection. His next step marked a great advance, for Brehmer argued that "anything which protects one man from falling ill must be able, if properly employed, to cure another of the same disease," and from this argument he evolved the modern treatment of tuberculosis on the following lines:—

1. A life spent in the open-air under conditions which give immunity from tuberculosis.
2. Complete freedom from any debilitating circumstances or anything which may lead to an exacerbation of the disease.
3. Methodical hill-climbing as an exercise when the condition of the patient renders this advisable.
4. Constant and unremitting medical supervision.
5. An abundant dietary in which milk, fatty food, and vegetables occupy an important place.
6. Various hydro-therapeutic measures.

Brehmer also insisted on the necessity of providing facilities, both for observation and research. These headings might stand fairly enough to-day. In the nature of things they tend to overlap one another, but it will probably conduce to brevity if we discuss them separately, first of all examining the scientific grounds upon which they rest at the present time and then drawing our conclusions as to what requirements they necessitate in the shape of buildings.

I.—A LIFE SPENT IN THE OPEN AIR UNDER CONDITIONS WHICH GIVE IMMUNITY FROM TUBERCULOSIS.

Conditions for immunity.—The idea that at a certain altitude there exists a zone free from tubercle was shown by Dettweiler and others to be erroneous, for tuberculous disease was found to be rife amongst the watchmakers in the High Alps, whilst it does not exist in the Khirjis Steppes, which are below the sea level, nor in the low-lying portions of Iceland. The keynote of Brehmer's treatment was not, however, a question of altitude or climate, but conditions which insure exemption from tubercle. He was wrong in thinking that these conditions could only be obtained at high altitudes; in fact, the observations of Finkelnburg and others have shown that the really essential climatic conditions for sanatorium treatment are those expressed in our instructions.[1] Brehmer was right, however, in thinking that tuberculosis could only be satisfactorily dealt with when the conditions under which the patient lives are identical with those which have kept others free from the disease; in 1855, when he first acted on the above ideas, our pathological knowledge on the subject was far from perfect and he could not have very exact information with regard to the etiology of tuberculosis. Owing to the rapid strides made by pathology and bacteriology, and especially to the discovery in 1882 by Koch of the tubercle bacillus, our knowledge, though still imperfect, is much more exact and extensive.

Conditions for infection.—We know now that tuberculosis depends upon infection with the tubercle bacillus and that this does not, and cannot, take place unless a man happens to be susceptible or, if we put it in other words, unless what we call, for want of a better term, his vitality has been so lowered by his surroundings, by disease, or by the quality and quantity of his food, that he is powerless to resist infection although previously immune. Anyone who has contracted tuberculosis shows thereby that his resistance has been lowered and that it is necessary for him to be protected from any source of further infection, more especially as we have no guarantee that he may not be further infected by tubercle bacilli of greater virulence than those which have already established a hold upon him. It has been shown that the form of treatment which does this most effectually, in the greater number of cases, is that carried out in a sanatorium conducted on open-air lines (see Appendix No. II., page 29). Before, however, we can discuss the character of such an institution we must consider in greater detail the various questions raised by the etiology of tuberculosis.

Infection by expectoration.—Koch, in 1882, showed that tuberculous disease depended upon infection with tubercle bacilli. These micro-organisms are contained in the expectorated mucus or phlegm of tuberculous individuals; and the one subject, upon which there was complete unanimity at the late Congress in London, was that tuberculous sputum is the most potent factor in the spread of infection. It is true that infection may arise from tuberculous disease of other organs or parts of the body than the lungs, but the spread of infection from these sources is not so great as in the case of pulmonary consumption although it follows the same lines. The bacilli are not, as a rule, contained in the breath, because the air in passing over the mucus attached to the walls of the bronchi does not carry off these micro-organisms. It has, however, been shown by Fraenkel, and especially by Flügge and his pupils, that in certain instances when tuberculous persons cough violently or splutter whilst

[1] "An elevated and sloping site with a sunny exposure well sheltered from the cold winds. A dry and permeable soil, together with an abundant supply of water."

Speaking small particles of phlegm are carried off with the breath and so become the source of infection.

Conditions for direct infection from a consumptive individual.—Flügge and Latschenko requested some consumptive patients to cough, but not to expectorate, in a large glass box. The patients had to wear new rubber coats and rubber shoes, in order to avoid any sputum being detached from their clothes, and so leading to error. Sterilised glass plates somewhat moistened were previously placed in the upper portion of the glass box. After the patients had coughed the expectorated material was scraped off these plates and inoculated into animals. All these animals developed tuberculosis. Somewhat similar results have been obtained by Boston. These experiments, taken in conjunction with Hiller's calculation that there may be as many as 100,000,000 tubercle bacilli in each cubic centimetre of sputum, show that consumptive patients may be a source of danger to those in their immediate vicinity, not only when they cough but also, in certain cases, when they speak. As we shall presently see, however, this danger can, practically speaking, be averted by the adoption of suitable precautions. The small particles of sputum may float in the air for 15 minutes to one and a half hours and whilst they are floating in the air they may readily affect individuals, who, so to speak, come within the line of fire. Thus Cornet has shown in his classical work that guinea-pigs become tuberculous, when made to inhale moist air containing tubercle bacilli; and Flügge, working recently on the same lines with the bacilli prodigiosi, showed that cultivations of these micro-organisms could be grown from the smaller bronchi of the animals exposed to the spray, provided that the animals were killed and dissected within half an hour of the experiment.

Infectivity of dust.—After these particles have floated in the air for a varying time they gravitate towards the ground and in doing so infect everything, such as furniture, books, and the like, upon which they happen to fall. Consequently the dust taken from the houses inhabited by consumptive persons has been shown by numerous observers to be infective. Cornet, who has been confirmed by Biggs of New York and others, showed that dust purposely collected from the wall behind the bed of a patient, or from the rails of the bed behind the patient's head, so that there was little likelihood of direct infection by coughing, and dust from tops of pictures, from cornices and from the floor when injected into guinea-pigs cause tuberculosis unless the patient had taken strict precautions about infection. Coates of Manchester showed that of dirty houses, occupied by a consumptive person, at least 66 per cent. yielded infective dust and that in the case of clean houses no less than 50 per cent. contained contaminated material; he, in fact, proved that ordinary cleanliness alone was not sufficient to prevent the accumulation of infective material in rooms occupied by a consumptive person. We see, then, that such an individual may infect the dust and furniture of his room. It has also been clearly shown that he frequently infects his clothes. Cornet completed our knowledge of the part played in infection by the tubercle bacillus when he showed conclusively that guinea-pigs may readily be made tuberculous when they are exposed to an atmosphere containing *dried* tuberculous sputum and that moisture is not an essential factor. Again, Spillman and Haushalter of Nancy have shown by extensive experiments that the common house-fly may become the propagator of tuberculosis by acting as a carrier of tuberculous dust.

The part played by clothes.—Probably, then, consumptive persons infect dust and this on being scattered infects other people who are in a condition to contract the disease. Brehmer, indeed, held that this infection by dust was chiefly by bedclothes, ordinary clothes, and above all by handkerchiefs. Every motion of the clothes causes little pieces of fibre, hair, and the like to break off, and it is through this fine dust, rather than the dried sputum on the floor which breaks into larger fragments, that infection takes place.

How to avoid these modes of infection.—The danger of infection by these means is a real one but it may readily be reduced to a minimum. Both Latschenko and Heymann have shown that for infection to take place in this way a close proximity to the patient is essential and that the infected particles are never projected beyond a distance of from three to five feet. Heymann (1901) has, moreover, ascertained that the *maximum* distance is reduced to three feet if the patient holds a handkerchief in front of his mouth when coughing. Flügge (1901) states that the air of a tuberculous patient's bedroom is not often infectious and that the floating dust to be dangerous must be present in clouds, as is the case, for example, in factories, or when rooms are swept. The danger is still further reduced inasmuch as many consumptive individuals have no tubercle bacilli in their phlegm and, still more, have none in their saliva, whilst most patients at a sanatorium rapidly lose their cough. That the adoption of reasonable precautions with regard to the sputum practically does away with the danger of infection by these means has been conclusively shown by the well-known observations and experiments upon the spread of infection in institutions for consumptive patients carried out by Cornet, Cotton and Theodore Williams, Heron, Hance, Achtermann, and others. It is on such precautions that we must rely rather than on antiseptics or isolation. We have learnt, in fact, that, as in surgery, so in tuberculosis, asepsis rather than antisepsis affords the best means of preventing the spread of infection. To give one example, Bryce showed by means of certain experiments that no tubercle bacilli could be found on the hands of 18 sanatorium patients who used pocket flasks but no handkerchiefs, whereas the hands of ordinary consumptive patients who used handkerchiefs were infective in no less than eight out of 10 cases.

Conclusions to be drawn from a consideration of the modes of infection.—Koch and others have shown that it is extremely rare for tuberculosis to be hereditary—that is to say, for the tubercle bacilli to be handed down directly from parent to child. The chief source of infection, then, apart from the question of infection by milk and food, which we shall briefly discuss later, is dust which has been infected by tubercle bacilli. It is clear that those precautions, such as the collection and destruction of sputum, which have been proved to be efficacious in preventing the dust from becoming infected must be adopted in any institution for the treatment of tuberculosis. As, however, patients may in an unguarded moment, or from neglect or accident, disseminate the bacilli, a sanatorium for tuberculous individuals should be constructed and equipped in such a way that the dust which inevitably collects can be readily removed. Further, every precaution should be taken against the formation of dust anywhere in the vicinity of a sanatorium, not only because such dust may become infective but because both dust and organic effluvia lead to bad results. The former excites useless cough and irritates the air passages, while the latter lowers the constitutional vitality and, as we shall see, fosters the growth of the tubercle bacillus. The grounds should therefore be laid out in such a way as to minimise the possibility of dust being carried by the wind; again, coal, that most potent factor in the formation of dust, should be used as sparingly as possible, and if used at all should be consumed as completely as may be, whilst the buildings should be well removed from roads and from human traffic.

Conditions which lower an individual's resistance to tuberculosis.—It is generally accepted that tubercle bacilli are harmless for those in a good condition of health—for those, that is, whose resistance has not been so reduced that they readily fall a prey to disease. We must consequently consider what circumstances lead to a diminution of resistance in order that we may be in a position to avoid them in the erection of our buildings. Long before tuberculous disease was regarded as infectious evidence was being accumulated to show that bad sanitary conditions, such as absence of sunlight or ventilation, bad drainage, and polluted subsoil, together with an insufficient supply of food, were the chief predisposing causes of consumption. The fact that insufficient or unnutritious food plays an important part in the etiology of tuberculosis rests on the firm foundation of our knowledge with regard to the etiology of nearly all diseases. "Where the sun and air do not enter the physician enters often" is an old Persian proverb, whilst the sanitary records of the last 60 years and the extraordinary diminution in the rate of mortality from tuberculosis which has followed the adoption of better sanitary conditions prove that close confinement and bad ventilation are among the most important factors in the etiology of this disease.

Effects of confinement.—One or two examples of the effect of confinement and bad ventilation will suffice. Cornet, in investigating the statistics of the mortality from tuberculosis in females, came to the conclusion that in sisterhoods where the above bad sanitary conditions obtain a healthy girl entering at 17 dies 21·5 years earlier than her sister

who belongs to the general population of the state; that such an inmate in her twenty-fifth year has the same expectation of life as a female of the outer world at the age of 45, and that a nun of 33 must be classed with a female outside at the age of 62. The same is true of animals, as Sir F. Fitzwygram has shown in connexion with the London cab-horse and as is well exemplified by the fact that whilst horses at one time died in large numbers from tuberculosis in the London Wellington Barracks owing to bad ventilation, yet very few died in the Crimea from this cause although they were constantly exposed to the effects of a rigorous climate. It is, in fact, now regarded as a law that where there is a high mortality from tuberculosis the sanitary conditions are imperfect.

On what do these effects depend?—The bad effect of close confinement and insufficient ventilation is due to the impurity of the air, to what has been called air sewage. Ehrenberg and many others have shown the enormous quantity of floating matter which exists in impure air and Pasteur laid it down as a law that air to be pure must be free from both organic and inorganic floating matter. Haldane and Lorrain Smith have shown that in respired air the only deleterious substance, apart from micro-organisms, is carbon dioxide gas, and it is an established fact that when this gas becomes appreciably increased over its percentage in the outside air the health suffers and the resistance of the body is impaired. In addition to the excess of carbon dioxide present in the air of badly-ventilated rooms we must mention the organic matter contained in the dust, the sulphuretted hydrogen and other gases given off from drains, from kitchen traps, and from insufficient coal decomposition, and, most important of all, the various forms of micro-organisms which are constantly to be found. Many of these micro-organisms, such as the varieties of streptococcus, not only lead directly to disease but are the cause of secondary infection in tuberculosis. We have said enough, then, to show that the most powerful predisposing cause of tuberculosis is foul air, and that, as Lord Beaconsfield once said, the atmosphere in which we live has more to do with human happiness than all the accidents of fortune and all the acts of Government.

How to avoid these effects.—Numerous observations by Angus Smith, Pettenkofer, and Moeller have proved that it is very difficult to maintain the ventilation of any building at such a pitch that the air contained within it has the same composition as pure outside air. Pettenkofer in his work on this subject has shown that in the open 324,000 cubic feet of air pass over an individual in an hour under ordinary conditions and that we cannot approach this amount in any building. Again, ozone is obtained only in the outside atmosphere. Many virtues are attributed by some authorities to this gas, but it is doubtful whether its presence has any value save as an index of the atmospheric purity. In any case Delépine has shown that ozone has no effect upon the virulence or life of the tubercle bacillus. We may conclude that our first aim must be to provide such ventilation that the air contained within our buildings does not essentially differ from the outside air. It has, indeed, been said that it is as unreasonable to ask people to breathe air which has already been respired and contaminated as to ask them to wash in water already used by others.

Conditions inimical to the growth of tubercle bacilli.—Foul air not only lowers our power of resisting disease, it also favours the growth of the tubercle bacillus. Koch, Arthur Ransome, Cornil, and others, have clearly demonstrated that under the influence of darkness and in the absence of any movement in the air the tubercle bacilli may thrive and remain virulent for many weeks, and even months, in the corners of a room, under beds, and behind articles of furniture, provided that the air contains a sufficient quantity of aqueous vapour and organic matter. Free ventilation, according to these authors, even in the dark, has the power of arresting the virulence of the bacillus provided there is no great excess of organic matter. Sawizky, however, asserted in 1891 that mere drying of tuberculous sputum induces only a gradual decrease of virulency and that in ordinary dwelling-rooms dried sputum will retain its infective power for two and a half months. It is known that diffuse daylight will cause the death of the tubercle bacillus in time, but this is most readily accomplished by free ventilation and direct sunlight. Ransome, who states that the bacilli may grow at the ordinary temperature on damp wall paper, has shown that under the healthy conditions of dry, pure subsoil, good drainage, free ventilation, and plenty of sunlight, the tubercle bacillus loses its virulence so rapidly that tuberculous sputum loses its infective power even before it becomes dry and is converted into dust.

Beneficial effects of an open-air life.—We see, then, that the best conditions not only for preserving and strengthening the resistance of the body to the inroads of the bacillus but for the ready destruction of the tubercle bacillus itself are obtained by an open-air life. Further, an open-air life must do much to starve out those micro-organisms, such as streptococci, which so materially assist the tubercle bacilli. Brehmer, following in Bodington's footsteps, grasped this truth before Koch demonstrated the infective nature of the disease, and as he argued that the circumstances which kept a man from tuberculosis must be the ideal ones for those already afflicted, he insisted on the importance of consumptive persons and others suffering from tuberculosis living as far as possible in the open air.

Exposure no drawback.—The great objection to Brehmer's view which was raised by medical men of his own time and, indeed, by many at the present day, was that patients, especially delicate people suffering from consumption, could not stand the necessary exposure. It had, however, long been known that tuberculosis runs a relatively rapid course in warm climates and that patients who gained weight and improved in health during the winter lost ground as soon as the warmer weather set in. Again, the health resorts which were most successful in the treatment of consumption almost without exception had been places which were cold, or at all events cool, during some part of the 24 hours. These facts, and the knowledge that animals with incipient tuberculosis recovered when they led an open-air life whereas they died if kept to the house, furnished strong support to Brehmer's views. Our experience for the last 40 years has done much to strengthen the position taken up by him. It has been found by experience that no amount of exposure to wet or any variation of temperature causes the most delicate patient to contract what is termed a chill, or to suffer any other harm, so long as an open-air life is led and the exposure is constant. If patients are well-nourished, sufficiently clothed, and sheltered from the wind, any degree of cold may be defied. At Falkenstein, for example, patients lie out of doors for many hours during thick fog and snowstorms and when the temperature is from 10° to 12° C. below freezing-point. Blumenfeld made an elaborate investigation of the harmful effects due to meteorological conditions at Falkenstein, but found that injurious results of this kind only occurred when north-east winds were prevalent. Andrord of Tonsnarsen, Norway, keeps patients from five to nine hours a day in the open air at a temperature of −25° C. without any bad effect. The same extreme cold is safely endured at the Charon Sanatorium near Boston and the Chestnut Hill Hospital near Philadelphia. Were fine weather and freedom from exposure a *sine quâ non* the remarkable success of the sanatoriums in the Black Forest, more especially of the Nordrach Colonie, and the favourable results recorded by Josselin de Jong with regard to low-lying districts in Holland, would never have been chronicled. The sanatoriums of the Black Forest have a moist and chilly climate during part of the year, but patients do at least as well at such seasons as in finer weather. Indeed, the results of treatment are better in winter than in summer. This was first pointed out by Grabilowitsch of Halila and has been confirmed by several continental authorities; in fact, no one claims to have better results in summer. That this is true not only of foreign sanatoriums but of sanatoriums in England is seen in Appendix No. III., page 30, where it is shown that in many cases the results are better in the winter months than in summer. At some institutions, such as the Victoria Hospital, Edinburgh, and the Hospital at Bridge of Weir in Scotland, heated air was at first employed; after a fair trial of this method Brehmer's plan of constant exposure to the temperature of the outside air was adopted and much better results were obtained. Again, it has been found that patients readily become acclimatised to exposure. In fact, the circulation in their extremities is so much improved at the end of a week or two in an efficient sanatorium that they cease to ask for hot bottles for their feet, whilst they develop such an "air-hunger" that they refuse to go into rooms in which the windows are not kept constantly open. Two further great advantages of an open-air life are the remarkable way in which it stimulates the capricious appetite of the patients and the beneficial effect it exercises upon various forms of distressing cough.

Exposure, when constant, does not lead to rheumatism.—It has been objected that patients may lose their tuberculosis in this way only to contract rheumatism. A personal experience may be of interest on this point. One of us used to suffer so frequently from rheumatic pains that he took great care to avoid any possible draught and to keep as far as possible at the same temperature. Some years ago he had occasion to spend a few weeks at Nordrach Colonie at a most inclement season. He followed the routine of the patients and sat, often for hours, bare-headed and with no great coat amidst the snow. He felt so much better in health that on returning to his ordinary life he adopted the Nordrach methods to a large extent and as a result has since been stronger and absolutely free from rheumatism.

Conditions for exposure.—We may say, then, that there is no danger from *constant* exposure in the climate of England. The patient needs pure air in all its natural simplicity. He must live in it, bathe in it continually. Discretion must naturally be used. Thus many patients, especially those with extensive disease, cannot stand exposure to wind, and what is good at 25 years of age is not necessarily good at 55. In extreme cold it is not always wise to have the windows widely open, as the cold air of winter circulates much more quickly than the warm air of summer. When the weather is extremely cold the patients' rooms may be slightly heated, and an attendant, on calling the patient in the morning, may close the window for him, so that he may avoid running the risk of getting out of a warm bed and dressing in a chilly atmosphere. The attendant may also close the window in cold weather before the patient returns from his walk or at bedtime and thus warm the room, but the patient must invariably open the window when he comes in, for his life, not only when in a sanatorium but ever afterwards, depends on his being hardened and on his becoming habituated to an open-air life of every and any degree of inclemency.

Conclusions.—It has been shown, then, that exposure to ordinary climatic conditions is no drawback to the treatment of consumption on open air lines, and that pure air is, from the point of view both of prophylaxis and of treatment, of the utmost importance. In what way may the air become contaminated? We have already seen that overcrowding, insufficient sunlight and ventilation, are the most potent factors. The buildings, then, of a sanatorium must, as we have said, be so constructed that the atmosphere within them rivals the outside air in point of purity. For example, the smell of cooking destroys the appetite of an invalid while fresh air stimulates it, consequently great pains must be taken to shut off completely the dining and kitchen arrangements from the patients' rooms. Again, though it may be possible to keep a room where a single patient lies fairly free from impurity, the atmosphere of any room in which a number of people are gathered together for any length of time will certainly become more or less contaminated and on this count alone it is obvious, that the use of recreation rooms or other places of assembly, such as churches, must be restricted within narrow limits. Finally the sanitation must be perfect and without flaw.

We are now in a position to say that in erecting a sanatorium arrangements should be made of such a kind that:—

1. The buildings are so situated, and of such a nature, that the formation of all dust is, as far as possible, avoided.
2. The dust, which inevitably collects, can be readily removed.
3. All infected material can be readily and effectually destroyed or disinfected.
4. The atmosphere of the buildings is free from all source of contamination and rivals the outside air in point of purity.
5. The number of recreation rooms and other places of assemblage is limited, and everything avoided which is calculated to tempt patients to stay in doors.

II.—COMPLETE FREEDOM FROM ANY DEBILITATING CIRCUMSTANCE OR ANYTHING WHICH MAY LEAD TO AN EXACERBATION OF THE DISEASE.

We have seen that even in health various circumstances may so lower the resistance of the body that disease is contracted and it is obvious that in the case of a man who is already debilitated by the ravages of tuberculosis many things which in health are possibly of little importance may cause a further loss of resistance and so lead to an exacerbation of the disease. Tuberculosis is a febrile disease in most of its stages and it is only during the last 50 years that we have learnt how small an indiscretion may lead to an increase of fever. In the treatment of this disease one of our main objects must be to maintain the temperature of our patients at a normal level. Anything which increases the fever or leads to the exhaustion of the patient assists the progress of the disease. All forms of excitement, whether mental or physical, encourage and intensify tuberculosis, whilst, as we shall see, nothing is so harmful as over-exertion of mind or body. *Everything which may lead to an exacerbation of the disease must be avoided so that the damaged tissue may have time to heal* and it must be constantly borne in mind that in a sanatorium the chief consideration is the recovery of health. For tuberculous individuals and their advisers this is a sufficiently difficult matter and one to which everything else must be subordinated.

Aggregation of the sexes.—What dangers, then, beyond those already mentioned must be avoided in the erection of a sanatorium? To take the question of the aggregation of the sexes first. There can be no doubt that patients who have comparatively little to occupy their minds and who in many cases are of an erotic temperament must be liable to considerable sexual temptation at a sanatorium. In our visits to sanatoriums we have observed much which confirms us in this opinion and the same conclusion has been formed by others. The sexual excitement which is engendered by such temptation is in most cases fatal to the progress of recovery and, without labouring the point, we are convinced that the individual bedrooms of the two sexes should be separated as much as possible in order that this source of temptation may be removed as far as may be. In certain sanatoriums, as at Hauteville, the sexes are kept apart; at others, as at Oderberg and Gluckauf, separate establishments are provided. There is, however, no reason why the sexes should not mix in the dining-room and in their daily life. It has been found that this not only does no harm but that in many cases it is productive of very good results.

Visitors.—A more difficult point is the admission of visitors to the sanatorium. It has been argued that the absence of friends may depress the patient and so retard recovery, but in those sanatoriums in which visitors are to all intents and purposes excluded it has been found that the distress at the absence of friends, though often marked when the patient arrives at the institution, rapidly wears off. On the other hand, it has been found that visitors do not readily accustom themselves to the necessary conditions, such as the ventilation, and that they often stir up trouble, though their intentions may be of the best. Anyone familiar with disease knows what an effect the visits of friends may have upon patients. It is true that in some cases the temperament is phlegmatic and no harm results, but in others the excitement consequent on receiving friends may lead to very grave results. It has been shown that the results obtained by treating consumptive patients at home are not to be compared with those obtained by the strict discipline of sanatorium life. Further, visitors to a sanatorium may introduce the germs of influenza or other debilitating disease, and Sir William Broadbent has expressed the opinion that the visits of friends should be restricted as far as possible, and that all visitors should be received in the open air. We may conclude, then, that in a sanatorium the more restricted the accommodation for visitors is the better, as their absence seldom leads to harmful results, whilst their presence is often injurious. Gerhardt has put this in other words: "Few people die of disappointment, but tuberculosis is a grave disease."

Amusements.—Turning to the question of amusements, we may say at once that it is only within recent years that the majority of the medical profession have learnt the great injury which may result in the case of tuberculous patients from free indulgence even in such apparently trivial amusements as games of cards. We have known a patient, in whom the disease was apparently quiescent, develop a temperature of 102° F. entirely from the excitement of a too animated game of bridge. In many others, playing the piano or taking part in theatricals has caused a considerable rise in temperature and done much to retard recovery. Brehmer experimented upon himself with regard to the effect produced by card playing on the metabolism of the body. He weighed himself after supper, and

again two and a half hours later, hours spent in reading or chatting, and in this way ascertained the variation of body weight under normal conditions for a week. He then played a game of cards for very small stakes every evening for another week and found that on the evenings on which he played cards he lost twice as much weight as on the other days. These experiments merit repetition, but experience supports Brehmer in his assertion that even card-playing may, in many cases, lead to bad results. Further, the temperature of excitable persons not infrequently is increased by reading inflammable literature, and it has been found by experience that the reading of many patients requires supervision. Amusements such as billiards, golf, and others, which necessitate exercise, will be considered in the next section.

Whilst it is true that certain amusements do harm in many cases, it is nevertheless the fact that other patients are benefited by being allowed to indulge in them. If, however, some patients are allowed too great freedom, and others are restricted, our experience, based on an intimate knowledge of many sanatoriums, is that the discipline suffers and those whose liberty is curtailed become restive. *Again, anything which encourages aggregation or remaining indoors must be avoided.* The decision in all cases of what amusement may be allowed must be left to the physician. When patients understand that indulgence of any kind retards their recovery they readily adapt themselves to the necessary discipline. The absence, however, of all amusements of any kind leads to *ennui*, and in the experience of all physicians anything which causes depression of spirits is injurious owing to the influence of the mind upon the body. Consequently, all that tends to make the patient happy and cheerful should be permitted; all that is cheerless and depressing should be banished from his surroundings, whilst the greater number of amusements of a harmless kind the better, such, for instance, as the art of photography or the science of botany. A library is an essential. It has been found that occasional short entertainments are productive of nothing but good; those patients who are about to leave the sanatorium may play the piano for the others, or short concerts or theatrical entertainments may be got up not by, but for, the patients from time to time. We see, then, that in the erection of a sanatorium the presence of a single recreation room which allows of the entertainment of the patients under open-air conditions may be an advantage.

Heating and draughts.—Amongst other debilitating circumstances we may mention exposure to draughts or to unnatural changes of temperature, such as are experienced when a patient goes from a hot room to a cold passage or gets into a cold bed. A sudden change of external temperature, or exposure to a draught frequently gives rise to an attack of bronchitis or other disease, which tends to retard recovery in tuberculosis. In other words, sudden alterations of temperature or exposure to a draught lower the the resistance, and give micro-organisms their opportunity for starting some complication, such as a cold or an attack of pneumonia. These micro-organisms are banished from efficient sanatoriums, and so colds do not occur. It is perfectly true that anyone may be hardened by exposure, and may not contract disease under conditions which would kill a man brought up on hot-house principles, but the fact remains that sudden variations of temperature—not the variations due to the alterations in the weather, for these are not sudden in the sense we are using the word—and draughts lower the resistance, therefore, they cannot be of service to consumptive patients and should be avoided, although the harm they may do may not be very apparent. We may say, then, that any heating arrangements must be of such a character, and the temperature reached of such a height, that no sudden variations can occur; that every precaution to prevent chilling of the patient should be taken, such for example as the use of sheets of a mixture of wool and cotton as these are worse conductors and less cold than linen; and that draughts should be avoided as they readily may be by making the inlet and outlet for the ventilation sufficiently large. Precautions must also be taken to prevent any diminution in the humidity of the air owing to the heating apparatus.

Exposure to winds.—One more debilitating influence may be mentioned. Blumenfeld and others have shown that exposure to winds, more especially to cold winds, is injurious, and the conclusions of these observers are borne out by the experience of all sanatorium authorities. The injurious effect of wind is due to two causes: first, the dyspnœa it excites; and secondly, the loss of heat which occurs in consequence of the great amount of air that passes the body. The site of the proposed sanatorium is to be well sheltered from cold winds, but, in addition, both in the grounds and elsewhere in the sanatorium, protection should be afforded by artificial and natural shelters against any excess of wind.

Exposure to the sun.—The sun is an amenity and a cordial and Rienzi has shown that it lengthens the lives of animals inoculated with tuberculosis; yet too great exposure to it is debilitating and, according to some authorities, leads in certain cases to hæmoptysis. Consequently, measures must be taken for protection against the sun in hot weather.

Conclusions.—We may conclude, then, that in a sanatorium:—

1. The bedrooms of the individual sexes should, as far as possible, be in separate blocks.
2. The accommodation for visitors should be strictly limited.
3. No special provision should be made for exciting amusements, but a well-stocked library and other forms of harmless recreation should be provided.
4. The means of heating employed should be easily regulated and of such a kind that they do not interfere with the humidity of the air.
5. Although there must be free circulation of air draughts should not be encouraged.
6. Efficient shelter should be provided against wind, sun, and heavy rain, not only in the sanatorium itself but in the grounds.

III.—Methodical Hill-climbing as an Exercise when the Condition of the Patient does not necessitate Repose.

The heart in tuberculosis.—Brehmer, as has been said observed that the inhabitants of Göbersdorf had powerful hearts and were free from tuberculosis, whilst tuberculous patients had small hearts and large lungs, and he came to the conclusion that anything which helped to strengthen the heart not only tended to ward off the disease but was a most hopeful method of treatment. Baudement and Nathusius had shown that in many animals, such as oxen, the lungs and heart are in proportion to the body weight. In other words, the greater the body weight, or the more the animals have eaten, the larger the heart and the smaller the lungs. Brehmer argued that many tuberculous patients, who nearly always have poor appetites at the growing period of life, have large lungs and small hearts in consequence of their low body weight. Other observers, such as Rokitansky and Andral, and more recently Hutchinson, support Brehmer in this view. On the other hand, some authors, amongst whom may be mentioned Meissen, deny that a small heart is at all common in tuberculosis. Whether this be so or not it is at least certain that the heart is distinctly enfeebled in this disease, and Leyden, Strumpell, and others have shown that partial atrophy of the cardiac muscle is not at all infrequently met with, so that there can be little doubt that anything which tends to increase the cardiac power is of value in the treatment of the disease. Von Ruck further holds that it is necessary to increase the power of the heart in tuberculosis of the lungs in order that it may be able to deal with the pulmonary obstruction caused by the disease. Brehmer, in accordance with his own views, insisted on his patients taking gradual and slow uphill exercise whenever this could be done without producing fatigue or other unfavourable results, and this method of treatment is followed in many sanatoriums at the present day. He held, however, that in many cases the exercise must be extremely moderate in amount, and, indeed, must often be replaced by entire repose—that is, repose both of mind and body—a condition which can be obtained only by more or less complete isolation.

Dettweiler's modification of Brehmer's treatment.—Dettweiler, however, introduced a modification of Brehmer's ideas and substituted rest in Liegehalle or verandahs, in place of uphill exercise, in the majority of cases. These two systems necessitate a different class of building and we must therefore discuss the questions involved a little more in detail. All sanatorium authorities agree that under certain conditions rest in isolation is necessary for consumptive patients. Such conditions constantly arise even in institutions restricted to patients in the very early stages of the disease. We, however, take it for granted that in the

case of the proposed sanatorium patients will be admitted in every stage of the disease which is likely to derive benefit from this form of treatment. We conclude that it is the gracious intention of His Majesty to found the sanatorium on model lines, so that the institution may not only be of service to the patients treated but of educational value to the world at large. There can be no doubt that the earlier cases benefit more than the later ones, but, on the other hand, improvement or arrest of the disease in the later stages affords a more striking lesson, and in other ways is of greater educational value.

Value of rest.—Whenever there is active inflammation in the lungs bodily rest is imperative. This is common sense and merely an adaptation of Hilton's classical essay on rest and pain. Hilton showed conclusively that in the acute stages of inflammation, whether it be of an extremity or of an organ, movement does nothing but harm. No one thinks of permitting exercise in the case of typhoid fever or of pneumonia, and the same should be equally true of the inflammatory stage of tuberculosis. This view is accepted in the case of tuberculosis of the hip-joint and should be adopted when the lungs are the seat of disease. In the case of pulmonary tuberculosis we know that as soon as inflammation commences nature takes prompt steps to diminish the movement on the side affected. Bonnet Léon and Walsham have shown by means of the x rays that under ordinary conditions the diaphragm does not become flatter on inspiration, as was supposed, but that it plunges up and down like a piston without any alteration in its curve. Whenever one of the lungs is affected, however, with tuberculosis, even if the disease is limited to the apex, the movement of the diaphragm is sensibly diminished on the affected side. Again, every pathologist knows that when the lungs become tuberculous adhesions are formed in the majority of cases between the lungs and the pleura. Nature, by means of these anchors and by diminishing the movement of the various muscles of respiration on the affected side, makes every endeavour to keep the diseased part at rest. Nature is usually a safe guide and experience has shown that in all stages of tuberculosis one of our chief endeavours must be to prevent anything which tends to throw a strain upon the lungs, such as dyspnœa or cough. One of our aims in sanatorium treatment is to maintain the temperature of our patients at a normal level. Now exercise is one of the chief causes of a rise of temperature in this disease and has, in fact, been used for diagnostic purposes. In the acuter stages of the disease pulmonary rest can only be insured by absolute bodily rest. In this way we allow the diseased part of the lungs time to heal by natural processes and the record of such treatment shows what excellent results may be obtained; the inflammatory process gradually diminishes and the disease becomes quiescent.

Disadvantages of too prolonged rest.—Just as in the case of a fractured leg there comes a time when massage and passive movements are imperative, so when tuberculous disease has become sufficiently quiescent exercise in some form or another must be taken. It is admitted by all physiologists that for the body to be in perfect health it must be maintained in activity. Exercise promotes not only the nutrition and energy of the voluntary muscles but also those of the heart, blood-vessels, and respiratory organs. It powerfully assists the aeration of the blood and in this way keeps all the tissues of the body in a healthy condition. An equally important function of exercise is that it assists in the elimination of various substances through the lungs, the kidneys, the bowels, and the skin. Another advantage, as Sir H. Weber has said, is that it strengthens the nervous system and counteracts the mental depression which has such a lowering effect on the vitality of the body. On the other hand, it has been urged, and justly urged, that patients who undergo treatment by rest in the recumbent posture become lazy in the extreme and never regain energy enough to resume their former mode of life. This is an important point in the case of patients who are not possessed of ample means, for we must endeavour, by every means in our power, to arrest the disease under conditions which are, as nearly as possible, those obtaining in the life to which our patients have to return. Meissen, who values the Liegehalle method, asserts that he has never seen a patient attain the maximum development of health by this measure alone. He has, he says, seen better results in those patients who have taken more exercise than they ought to have done. Brehmer was convinced that the reason why Dettweiler at one time obtained unfavourable results, and thus was led to alter his treatment, was that the patients at Falkenstein were allowed to walk too fast and that the return walk was often uphill. Dettweiler himself has freely confessed that the method of treatment which he introduced may be carried to an extreme; for when the patient is kept at rest for long periods, even in the quiescent stage of the disease, there is a rapid gain of weight, which consists largely of fat rather than muscle or bone, and a time comes when the capacity of the lungs and heart is overstepped and the patient becomes more breathless than before. Sir R. Douglas Powell has observed that such a transgression of the physiological balance of the cardio-respiratory functions and body weight is to the positive disadvantage of the patient and results in an attack of dyspepsia, diarrhœa, or hæmoptysis, by which nature attempts to rectify the effects of our want of foresight. Patients with extensive disease are, indeed, more comfortable if their weight does not exceed a certain limit. Knopf, too, who was at one time Dettweiler's assistant, asserts that the recumbent position necessitated by Liegehalle facilitates hypostatic congestion of the lungs, and that the patients' backs become more sensitive to changes of temperature. The relative statistics of "cures" which have followed on the adoption of these two forms of treatment cannot be accepted as a guide for many sufficiently obvious reasons, but remarkably good results are obtained at such places as the Nordrach Colonie, where exercise is prescribed at the earliest possible moment. We may confidently assert from our own observations of many cases treated by both methods that the Liegehalle system does not lead to such good or to such permanent results as the system adopted by Brehmer and Otto Walther. It must be remembered that cases in all stages of the disease are admitted at Nordrach and that the good results there are obtained, not only in the early stages of the disease, but also in the more advanced ones. If, then, exercise benefits patients with extensive disease it cannot fail to be of service to those whose disease is less advanced. Finally, at several sanatoriums, as, for example, Dr. Driver's at Reiboldsgrün, better results have been obtained, since patients were permitted to rest in shelters and in the woods rather than in Liegehalle. We see, then, that there is much to be said for exercise and but little for complete rest in certain phases of the disease. We may also conclude that the form of exercise adopted must be of such a kind that, whilst it leads to active and healthy metabolism, it does not throw any strain upon the lungs or excite dyspnœa.

Where should the patient rest?—It is clear, however, that rest must frequently be enforced by the physician, for example, when there is active inflammation and, as we shall see, for an hour before the midday and evening meals, even when the patient is convalescent. How can this rest be most efficiently secured? Is it most easily obtained in Liegehalle or in the seclusion of the patients' own rooms?

Objections to verandahs.—In the first place, in many cases in which rest is necessary the effort involved in going from the bedroom to the verandah, or of leaving it for meals, or for certain physiological processes, entails too much exertion. Again in verandahs patients tend to collect in chattering groups and, forgetful of advice, gesticulate and become excited, so that dyspnœa or cough is induced; whilst many who need absolute quiet make efforts to entertain their neighbours. If intervening glass screens are placed to prevent this one of the main values of a verandah is lost. In addition there are many structural objections to Liegehalle; in the climate of England they block out too much light, unless the building is so arranged that they are placed before a basement or the interval between the storeys is much increased, both of which procedures lead to a large outlay without any compensating advantage. Verandahs are not easily kept clean, in the strict sense of the term, and in the nature of things cannot contain as pure an atmosphere as is found in the open, or even at the window of a room that contains only one person; further, they interfere with the privacy of patients confined to bed, and may disturb their rest, whilst in summer they sometimes tend to become insufferably hot.

Absolute rest possible only in seclusion.—Brehmer and others, recognising the enormous part that the mind plays in the question of bodily health, insisted that when rest was required it should be absolute; that both mind and body should be free from all forms of excitement. They held that this can only, as Leriche has proved, be done by means of

complete seclusion and the results obtained by them have more than justified their assertion. They have, however, found that in a small number of instances the patients tend to become depressed and fail to make progress when isolated in this manner and they have come to the conclusion that patients of this class when kept at rest do best when they are allowed to associate with not more than two or three fellow creatures for an hour or two daily, preferably in open-air galleries to which their beds may be wheeled. We see, then that most patients, when their condition necessitates rest, should be confined to their own rooms. Most medical men object to a patient remaining for long in a single room, but, as we shall show, such a room may be most freely ventilated and this argument therefore loses its force. Further, in a sanatorium there should be some form of open-air gallery, provided that not more than three, or at most four, persons are allowed to assemble together.

When should exercise be prescribed?—A more difficult question which we now have to answer is, Under what conditions should exercise be prescribed? Nowhere in the extensive literature on the subject are these conditions laid down, whilst the answers given to this question by the medical men in charge of a number of sanatoriums, which are brought together in Appendix No. V., page 31, show that no absolute rules can be given. The reason for this is that the conditions under which exercise should be prescribed depend largely on the personal equation of the patient and can can only be dealt with, and properly appreciated by, the physician in attendance on the individual merits of each case. This, indeed, is one of the most valuable lessons which the sanatorium method of treatment has taught us. There can be no rule; it may, however, be said that exercise may be prescribed whenever it does not tend to exacerbate the disease, and that this can only be determined in each individual case by experiment guided by the observation and experience of the physician. It is true that a patient should be kept in bed until he can take ordinary food and that certain conditions, such as the height of his temperature, the rapidity of the heart's action, a ready tendency to exhaustion, extensive or rapidly-advancing disease, or an irritable nervous system, may contra-indicate exercise and necessitate repose. A temperature of 98·6° F. in the morning may indicate the desirability of rest in certain cases, but we have known patients with a temperature of 100° or more fail to make any progress until they were permitted to take a certain amount of exercise.

What form of exercise is advisable?—When exercise is prescribed what is the best form? More people suffering from tuberculosis have been killed by over-exertion than by anything else. Exercise must therefore never be pushed so far as to cause fatigue or to lead to a return of fever or cough or to any other bad symptom. For some patients slight massage or the more exertion of dressing may be enough, others may only be able to walk a few yards on level ground. Others, again, of the well-to-do class may benefit by driving slowly in ordinary carriages or in suitable electric motor-cars, but for the majority of quiescent cases experience shows us that the best form of exercise is regular up-hill climbing. Such exercises must be gradual and deliberate; the gradient must be easy and the pace should not, in many cases, exceed two miles an hour. The patients must not hurry, even if caught in a shower, for any increase in the number of respirations does harm in that it increases the work of the lungs. Every provision must be made for the patient to rest if he is at all tired; whilst the sanatorium must be so situated that patients are not tempted to start down hill and return up-hill. Both the public and the medical profession are too much afraid of a little rain or mud, and one objection urged against this form of exercise is that it may lead to exposure to heavy rain or inclement weather. The experience of the sanatoriums, where this form of treatment is practised, on the other hand shows that it leads to very good results.

What protection should be afforded?—The only precaution taken in these institutions is shelter from wind; it is argued that no rheumatism and no chill result even from a thorough wetting and some authorities go so far as to prefer their patients not to change their clothes even when wet through. The general consensus of opinion, however, is that even if wet clothes do not lower the vitality they can at least do no good. Again, it is uncomfortable to remain long in wet clothes, so that adequate provision should be made in a sanatorium for drying the patients' garments. Protection may be obtained by means of trees or suitable shelters in the grounds and the paths should be so constructed that they absorb moisture and readily dry after rain. Exercise under cover, as Brehmer has shown, cannot, save in exceptional instances, be of service, as it is impossible to keep the atmosphere sufficiently pure where any number of people are assembled together. No provision, then, need be made for exercise under cover, although there can be no objection to suitable covered passages which are freely open at the sides being erected between certain of the different buildings, more especially as these conduce to the comfort of the patients by sparing them unnecessary exposure to rain.

Are other forms of exercise advisable?—Slow walking uphill, on easy gradients, as we have seen, is the best form of exercise for patients suffering from pulmonary tuberculosis, but in view of the fact that at many sanatoriums certain exercises, such as billiards, tennis, and golf, are allowed, we must say a few more words on this subject. As Sydenham long ago pointed out, horse exercise is often of service to tuberculous individuals, and provision may be made in this direction for the better class of patient. Games like billiards, tennis, golf, and others which involve much exertion and tend to excitement are injurious unless the disease is practically arrested, in that they cause dyspnœa, raise the temperature, and lead to an exacerbation of the pathological process. Brehmer recalls cases in which he considered that hæmoptysis was directly brought on by a game of billiards, either from patients stretching over the table or holding their breath when making a difficult stroke. It is true that some persons afflicted with tuberculosis may indulge in such pastimes without apparent harm, but these patients are sufficiently improved to be able to leave the sanatorium, whilst, if they remain, they must inevitably postpone the admission of more suitable cases. That the avoidance of any over exertion is of great importance is shown in Manders Smythe's account of his own case, in which he relates how, after months of improvement, he suffered a relapse, owing to a comparatively trivial amount of tobogganing—a relapse which cost him five months of extra treatment. Such an example of harm resulting from the imprudence of patients is far from uncommon.

Another form of exercise which is not infrequently practised at sanatoriums, is pulmonary gymnastics, by means of the pneumatic cabinet and other contrivances, the idea being that the healthy portion of the lung is hypertrophied and so the loss of tissue compensated. Brehmer, Liebermeister, and Volland were strenuous opponents of this form of exercise; Baümle asserts that it has set up aspiration pneumonia; Michaelis and others have recorded instances of harm resulting, whilst at the Volksheilstätte Loslau it has been tried and given up. Many authorities, on the other hand, show good results from this form of treatment in cases in which the disease was practically arrested. Such exercises may readily throw a strain on the lung in cases where tuberculosis is not permanently arrested and may thus set the smouldering disease aflame; the limits of compensation are readily overstepped, with the result that a harmful emphysema may be developed. On the other hand, it is a question whether such expansion of the lungs is necessary, for, as C. Theodore Williams has pointed out, the human body has a much larger lung surface than is required for ordinary respiration. Thus, under ordinary circumstances, an individual does not expand his lungs more than one half, whilst a patient may exist in bed with an expansion of one-twelfth. Loss of lung tissue does not necessarily mean that the respiratory capacity is below the ordinary needs of the patient. There is ample lung surface in most consumptive individuals to deal with the amount of blood in the body, and there is no necessity for them to inflate their chests unduly and thus run the risk of strain, the development of emphysema, and with the latter the tendency towards hæmorrhage.

Conclusions.—We may conclude, then, that:—

1. Arrangements must be made for four classes of patients.
   - (*a*) Those who can take exercise more or less freely.
   - (*b*) Those who can only take slight exercise on level ground.
   - (*c*) Those who should be isolated in their own rooms.

(*d*) Those who though unable to take exercise should be allowed to associate with a few other patients in a small open-air gallery or other form of shelter.

It must be borne in mind that those cases which are included under (*a*) and (*b*) not infrequently relapse and so come under either (*c*) or (*d*).

2. A few open-air galleries are of service, but nothing approaching the liegehalle system should be erected.
3. Numerous paths should be provided, some on level ground and others of various gradients for uphill exercise. All must be of such a character that they readily dry after rain.
4. No special arrangement need be made for exercise in bad weather under cover, though it is as well to provide covered passages between certain of the different buildings.
5. Adequate accommodation must be afforded for drying clothes.
6. Exercise, such as billiards, tennis, golf, and pulmonary gymnastics, which tends to cause dyspnœa or undue expansion of the lungs, should not be allowed in a sanatorium unless it is reserved for essentially quiescent cases.
7. Some of the more wealthy patients may be allowed horse exercise, whilst many patients derive benefit from suitable carriage exercise.

IV.—An Abundant and Varied Dietary in which Milk, Butter, Fat, and Vegetables occupy an Important Place.

Nature of kitchen requirements.—A marked feature of tuberculosis is the loss of appetite which results from the progress of the disease, and it is consequently agreed upon all hands that in the treatment of this disease one of the most important points is to ensure that sufficient nourishment is taken to make up for past loss and to maintain the body weight appreciably above its normal value. In this way the process of repair is stimulated, the resistance of the individual increased, and the susceptibility or tendency towards relapse lessened. So true is this that Sir R. Douglas Powell considers the sanatorium cook to be only second in importance to the physician, whilst Dettweiler, when asked whether he used drugs much in the treatment of consumption, pointed to his kitchen and exclaimed, "That is my pharmacy, there is my chemist's shop." The object of the dietary is to increase the weight gradually to the normal, or somewhat above the normal, value, for, as Weir Mitchell has shown, a gain in weight up to a certain point goes hand in hand with a gain in all other essentials of health. By weighing the patients once a week a good guide up to a certain point is obtained of their progress and at the same time a healthy and friendly rivalry is established between the individuals. The quantity of food eaten must be considerable, must at least equal in amount that which is eaten by an ordinarily healthy individual, whilst patients must be made to eat everything they are given under pain of being sent away, as this disciplinary measure is productive of most excellent results. Although it is found that solid food is infinitely the best and that in many cases it affords the readiest means of reducing fever, yet in a sanatorium, owing to the different stages of disease which are treated, the diet must range from the fever diet of a hospital to a full diet of plain and wholesome food. Consequently the kitchen arrangements must be such that they can meet these demands. Further, as is now well known, food is liable to become poisonous when stored in unwholesome surroundings, and it is therefore necessary that the kitchen, larder, and other offices should be dry, well ventilated, and free from any source of contamination.

Facilities necessary for the analysis of certain articles of food.—With regard to the character of the food we may say at once that tuberculous patients do best on an ordinary diet to which an excess of fatty material is added. Otto Walther lays great stress on the amount of butter which his cook gets into the gravy in as pleasant and unobtrusive a guise as possible and on the amount of starch in the potatoes. Walther, in fact, has the potatoes and other articles of food carefully analysed before use, so that a thoroughly equipped sanatorium should have facilities for analysis of this kind. Brehmer insisted on the importance of an ample supply of vegetables, as he said that without them patients with advanced disease chew the meat, roll it from side to side, and are unable to swallow it. Vegetables, on the other hand, need little chewing, but are easily swallowed, and help the deglutition of other food. Further, vegetables contain much of the carbohydrate material recommended by Strumpell and Eichhorst. A sanatorium should therefore have a well-stocked kitchen garden. Fruit is a most useful adjunct and a room should be set apart for its storage.

Are arrangements to have milk free from tubercle bacilli necessary?—Milk is one of the best foods for putting on weight, and the question arises whether, in view of the large number of tuberculous cows in existence, precautions should be taken to sterilise it or whether it should be obtained only from animals which have passed the tuberculin test. Koch has shown that human tubercle bacilli have not, as a rule, sufficient virulence to infect cattle, and he has argued that there is no evidence to show that human beings are affected by bovine tuberculosis. It has, however, been shown that the two varieties of bacilli have the same morphological, cultural, and tinctorial characteristics, and that cattle suffering from tuberculosis give a reaction to tuberculin made from human tubercle bacilli. Dinwiddie, Ravenel, and others have further proved that of the various forms of animal tuberculosis bovine tuberculosis is the most virulent. These authors have been able to infect every kind of domesticated animal with bovine tuberculosis and it would be indeed strange if human beings were unique amongst animals kept under domesticated conditions as being immune to bovine tuberculosis. That, however, they are not was conclusively shown at the late Congress in London by the fact that veterinary surgeons have been inoculated on their fingers with bovine tuberculosis and have subsequently developed the disease. Whether such infection is at all frequent is still *sub judice*, but until the Royal Commission now sitting in England and in Germany prove the contrary we are justified in saying that [illegible]y the patients should be sterile, more especially the fact that patients with tuberculosis are pro[illegible]able to further infection, possibly with a more virulent [illegible] of the bacillus, than ordinary individnals. Milk should be sterile. English people, according to Sir R. Thorne Thorne, are the only civilised people who habitually consume uncooked milk owing to their rooted objection to boiled or scalded milk. Consequently, the milk used should be obtained from healthy cows but should not be boiled. Great care must be exercised in the feeding of the cows, every arrangement being made in the cowshed and the dairy for keeping the animals healthy and the milk free from contamination. Butter is used in this form of treatment in very large quantities and should be above reproach. Meat may occasionally be the cause of infection, but any danger from this source is readily avoided by sufficient cooking.

Conclusions.—We may conclude, then, that:—

1. The equipment and the sanitary arrangements of the kitchen, larder, &c., must be of the most modern type.
2. Every precaution must be taken in the dairy of the farm to ensure a large supply of milk and butter which is pure and free from tubercle.

V.—Various Hydro-therapeutic Measures.

Necessity for an adequate provision of baths.—One of the most noticeable features in tuberculosis when at all advanced is the unhealthy character of the skin. Perspiration is readily produced, whilst parasitic skin affections, such as pityriasis versicolor, are frequently met with. It has been found that the best way of improving the action of the skin and at the same time diminishing the liability to what is termed a chill is by appropriate hydro-therapeutic measures, more especially by means of some form of needle or shower bath, combined with friction, provided always that the individuals are not allowed, by vigorous drying or in any other way, to tire or over-exert themselves. In some of the continental sanatoriums a great parade is made of the bathing portion of the establishment, but in England, where the daily use of a cold or tepid bath is so much more common, there is no necessity in erecting a sanatorium to do more than furnish an adequate supply of the necessary bathrooms.

VI.—Facilities for Observation and Research.

Special accommodation for dental or throat operations, the use of x rays, and the like, which are necessary adjuncts

to a sanatorium, together with laboratories for routine examinations, should be provided. In addition, enough has been said to show the many opportunities that exist in a sanatorium for the prosecution of research. Such questions as the possibility of re-infection, the varying virulence of tubercle bacilli, and the diagnosis by means of serum agglutination must be elucidated by the help of appropriate bacteriological and pathological laboratories. Many problems, such as those considered by Bardswell as to the effect of different kinds of food and the various metabolic changes which occur in tuberculosis, must be considered in a chemical and physiological laboratory. Of late years it has been the fashion to neglect atmospheric changes completely, but it is nevertheless a fact that certain climatic conditions exert different effects on individual patients. One patient may benefit by a relatively high humidity, another may require a drier atmosphere, and in our opinion the varying effects of atmospheric conditions upon the well-being of the patients should be carefully worked out by the establishment of a meteorological observatory such as has long existed at Görbersdorf. Finally, every facility should be provided, in the shape of a record room, for keeping full notes of the patients' progress.

VII.—CONSTANT MEDICAL SUPERVISION.

Need of supervision.—We have seen in the previous pages that sanatorium treatment is based upon a careful regulation of a patient's life in all its hygienic and medical details and it is to the attention to detail and to the avoidance of what is harmful that this form of treatment for tuberculosis owes its extraordinary results and its superiority over all other forms of treatment. Solly has shown by statistics that in the beautiful climate of Colorado there is an enormous difference in the mortality among consumptive patients under medical control compared with that of those who merely consult a physician when they think it necessary. In order to direct a sanatorium efficiently the physician must have absolute power, he must be an autocrat and his word must be law. He must be prepared to give his entire energy to the work, for, as Dettweiler has expressed it, a sanatorium must be his religion, his politics, his despair, and his delight. He must be a man of many parts; he must gain the confidence, and if possible make allies, of the patients, prevent imprudence in some cases, encourage perseverance in others, strictly enforce all essential rules and yet allow sufficient liberty in less important details to prevent the irksomeness of restraint. Tuberculous individuals have a happy-go-lucky way of following their own devices and are in constant need of supervision. One of the many lessons sanatorium treatment has taught us is that every detail likely to exercise an influence upon either the condition of the general health or upon the course of the disease must exercise the physician's most earnest attention. Even in health people differ greatly in their power of reaction, so that what is bracing to one is depressing to another. What is one man's meat is another man's poison is an old saying, but never more true than of tuberculosis. In this disease we have an ever-changing picture. In its treatment there is no fixed rule and such general rules as exist have to be altered more frequently than they are followed. Each tuberculous individual must be dealt with on his merits, his personal equation, and his power of reaction must receive the most painstaking consideration. It is only by constant medical supervision that we can take advantage of the variations in the patient's condition or prevent harm. Each patient must be visited by the medical man before breakfast and again twice a day, for example, after the morning and afternoon walk, so that he may see at once whether any exhaustion or other bad effect has supervened, and map out the daily details of the individual patient according to his condition. Patients kept at rest may occasionally require even more frequent visits. Again, the physician must take his meals with the patients. In this way he can apportion the amount of food according to the varying requirements. He can sit near and encourage those who have any difficulty in eating the rather large quantities of food which are necessarily given them and he can do much to prevent by his presence the many petty deceptions, such as the pocketing of food, of which experience has taught us sanatorium patients may be guilty. The grounds must be as far as possible overlooked by the physician, so that he may be able to observe the patients' doings and see that they carry out his instructions. He can in this way often discover that the reason why a patient does not improve is because he walks too fast when he thinks he is out of sight or commits some other folly. Experience has shown that when patients believe themselves to be within the doctor's sight they are more careful to observe the necessary regulations.

Conclusions.—We may conclude then that:—

1. The buildings of a sanatorium should not extend over so large an area that effective medical supervision is in any way interfered with.
2. The quarters of the medical staff should, as far as possible, overlook the grounds.
3. The medical staff does not require a separate dining-room.

THE MAIN PRINCIPLE OF SANATORIUM TREATMENT.

Modern aspect of Brehmer's essentials.—The main principle, then, running through the sanatorium treatment is to treat tuberculous disease on common-sense lines; in other words, to develop by every possible means the resistance of the body so as to render the tubercle bacilli innocuous. Brehmer's essentials may now be modified as follows:—

1. A continuous supply of pure fresh air with no unnatural variations of temperature.
2. The avoidance of reinfection and of all sources of irritation such as dust.
3. Good nourishing food in sufficient quantity to establish and to maintain the normal body-weight of the patient.
4. Constant supervision by a skilled physician, who so orders the patient's life that he avoids everything which is harmful and takes advantage of everything which helps the process of repair or develops the powers of resistance.

We will now briefly state the necessary daily routine of a patient who is allowed to take active exertion in order that the general lines of the form of treatment we advise may be clearly grasped.

DAILY ROUTINE.

To take the case of a convalescent patient in the colder months. The patient is called at seven in the morning, and the windows of his room are then closed in order that he may not be chilled whilst dressing. He takes his temperature and rises not later than 7.30 and then has a shower bath at a temperature, in most cases, agreeable to himself. On completion of his dressing he must open the windows. Breakfast is at 8 o'clock. Directly after breakfast, or at 8.30, the patient starts out on his morning walk, the length of which is graduated according to his condition. He walks deliberately and slowly until he has arrived at his destination and waits there, resting in the fresh air but protected from the wind, until it is time for him to start home again. At 11.45 he must be in his room, where the windows have been already shut, and take his temperature. In five or 10 minutes he must open the windows. Between 12 and 1 o'clock he lies resting at full length on a sofa chair. At 1 o'clock he leaves his room and has luncheon, the principal meal of the day, with his fellow patients. Not later than 2.45 the patient starts on his slow afternoon walk which is the shorter walk of the day. He rests as before when he arrives at his destination and slowly returns, so that he reaches home at 5.30, or if it is very cold at about 4.45. He again takes his temperature, opens the windows, which have been closed shortly before his return, and rests until dinner time. At 7 o'clock he joins the other patients at dinner. After dinner many of the convalescent patients may spend half an hour to an hour in the recreation-room. They retire to their own rooms by nine o'clock, open their windows, take their temperature, and should be in bed by 9.30 or 10 o'clock. As may readily be seen from the preceding pages, the above routine may have to be frequently altered to suit the varying requirements of the different phases of the disease. Each patient, as we have said, is visited at least three times a day by the physician; he is weighed once a week, whilst every fortnight his chest is thoroughly examined and every month his sputum is tested.

TABULATION OF REQUIREMENTS TO BE MET BY A SANATORIUM.

We are now in a position to tabulate the requirements to be met by a sanatorium at which the treatment of tuberculous disease may be carried out efficiently, apart from the question of *personnel*, with which we shall presently deal.

It is agreed that the accommodation for all patients must be comfortable, a separate room being provided for each; that the sanatorium should be on an elevated and sloping site with a sunny exposure and well sheltered from cold winds; that it should have a farm at a convenient distance, be surrounded by extensive grounds, well wooded, and affording ample space for exercises of various kinds; that the soil should be dry and permeable and the water-supply abundant; and that it must be fitted with the latest sanitary arrangements and equipped with all requirements for scientific research. In addition we have shown in the preceding pages that:—

1. The ventilation should be such that the air contained within the rooms and passages is free from all sources of contamination and rivals the outside air in point of purity, whilst at the same time draughts are not encouraged.
2. The buildings should be so situated and of such a kind that dust is as far as possible avoided.
3. The buildings and the fittings should be of such a kind that such dust which inevitably collects can be readily removed.
4. Arrangements should be made for the ready and effectual destruction or disinfection of all infected material.
5. The buildings should be of such a nature that constant medical supervision can be readily exercised.
6. The doctor's quarters should, as far as possible, overlook the grounds.
7. The bedrooms of the sexes should, as far as possible, be in different blocks, but there is no necessity for separating the men and women in the dining room or grounds.
8. Four classes of patients must be provided for both in the sanatorium and in the grounds:—
   (*a*) Those who can take exercise more or less freely.
   (*b*) Those who can only take slight exercise on level ground.
   (*c*) Those who must be isolated in their own rooms.
   (*d*) Those who, though unable to take exercise, may be allowed to associate with a few other patients.
9. The accommodation for visitors must be limited.
10. No provision, so far as the buildings are concerned, need be made for amusements beyond an entertainment room which may also serve the purposes of a library.
11. No provision should be made for games such as billiards, golf, and tennis, which involve much movement of the arms or lead to excitement.
12. A few open-air galleries are of service but nothing approaching the Liegehalle system should be erected.
13. The dining-room and kitchen should be completely cut off from the patient's rooms, but no separate dining-room need be provided for the medical staff.
14. The kitchen arrangements should be of the most modern type and thoroughly sanitary.
15. The dairy and the farm should be of a model character.
16. There should be ample accommodation for hydrotherapeutic measures.
17. Adequate arrangements should be made for drying clothes.
18. The heating arrangements should be such that the temperature is never raised more than a few degrees above the outside temperature, so that no sudden variations are experienced when the patient leaves his room, and that the humidity of the air is not sensibly diminished.
19. Adequate shelter should be provided in the grounds and elsewhere against wind, excessive sun, or heavy rain.
20. No special arrangements need be made for exercise under cover in bad weather, though it is as well to provide covered ways between certain of the different buildings.
21. All facilities should be provided for the treatment and clinical observation of the patients by the aid of laboratories and special departments.
22. The facilities which should be provided for research include more especially facilities for observations in bacteriology and pathology, chemistry, physiology, and meteorology.

PART II.

We must now make an attempt to meet the various requirements we have formulated by the erection of suitable buildings, but before doing so we must arrive at some decision as to the special forms of tuberculous disease which are likely to derive benefit from treatment in a sanatorium. Children usually interfere with the necessary discipline and require special arrangements for their education; further, they make greater and more rapid progress, according to our experience, when treated in an establishment specially set apart for them. We do not, therefore, propose to find any accommodation for children. We think it right to find accommodation for those patients who are suffering from pulmonary tuberculosis and from one cause and another have to be confined to bed for weeks or possibly months. Although these patients may remain a considerable time in the sanatorium, yet the improvement in their conditions tends to arrest the attention of the public more than the results obtained in less advanced cases and in this way the severer cases may prove of distinct service in educating the public mind as to the value of the treatment. The class of case suffering from tuberculosis, which is refused at various sanatoriums, is shown in Appendix No. IV., page 30. Those surgical cases which require rest, such as cases of hip-joint disease, may be treated as satisfactorily, if not more so, at a seaside resort as at a sanatorium. Other forms of the disease, such as lupus, tuberculous glands, tuberculous laryngitis and disease of bone in the arm, may derive great benefit from sanatorium treatment, but these necessitate no special structural arrangements beyond the provision of an operating theatre and examining rooms.

We may now turn to the

QUESTION OF THE GENERAL CHARACTER OF THE BUILDINGS.

Whether the sanatorium should consist of one large block or several smaller ones?—Existing sanatoriums, as may be seen from Appendix No. VII., page 32, fall under two groups—namely, those sanatoriums which consist of one large building and those which consist of several. Both systems have their advocates. Their respective advantages and disadvantages may be tabulated as follows:—

ONE LARGE BUILDING.

Advantages—

(*a*) Less costly to erect and to maintain.
(*b*) More readily and more cheaply supervised.
(*c*) Sanitary arrangements simpler.
(*d*) Readier access of patients to common rooms.
(*e*) Lifts more readily provided.

Disadvantages—

(*a*) Much noisier than smaller buildings; for example, the sound of coughing (by advanced cases confined to their rooms) may be heard in the dining room and prevent sensitive patients from eating.
(*b*) Impossible to ventilate or to vary the ventilation and temperature for special cases so satisfactorily as in smaller buildings, more especially when there are several floors. The smell of cooking may, for example, penetrate the bedrooms of the patients, or rooms on one floor may ventilate into those above.
(*c*) Much greater difficulty than in smaller buildings in classifying the patients according to their condition; and of avoiding the moral effect which severe cases have on those who are comparatively well.
(*d*) Greater difficulty in isolating any cases of infectious disease.
(*e*) Not so readily extended; for example, additional small buildings are subscribed for more readily than the extension of a single large building.

A subsidiary point is that the smaller roof area of one large building collects a smaller amount of rain water for laundry purposes.

From a strictly medical point of view there can be no doubt that numerous small buildings within such limits that supervision is practicable are the best. Many of the older sanatoriums which are on the one block system were adapted from ordinary houses; others of the one block system are now being extended by means of smaller villas; whilst in most of the more recent sanatoriums for a large number of paying patients the separated house system is adopted in some form or another. Naturally, national prejudices have to be taken into account and what may be suitable for snowy Switzerland or sunny Colorado may not be suitable for England. We prefer the separate block system. It is impossible, however, to give a definite opinion on this matter without knowing the character of the site and the local configuration of the ground; for example, the separate block system necessitates that the proposed site should have sufficient shelter and protection for all the buildings. Then, again, the question of expense must enter largely into the decision. Consequently, although our plans have been drawn up from the point of view that the system of several separate houses is the best, we have added an alternative plan, which embraces the same principles on the one block system in case either the site or financial considerations should necessitate its adoption.

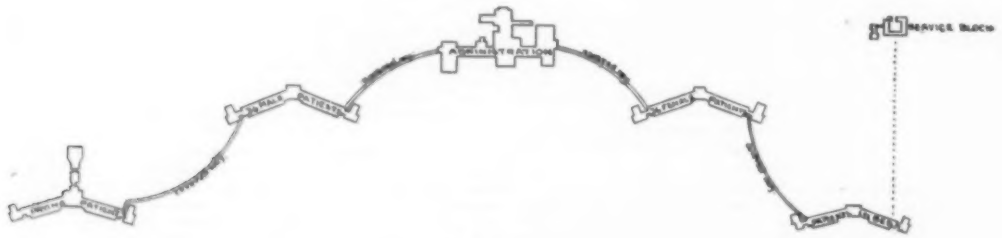
THE NECESSARY BUILDINGS.

We must have a maintenance block, in which the dining and kitchen accommodation for the majority of patients is placed, and an engine-house, together with laundry and other accommodation. We consider, further, that the 12 well-to-do patients should have a block to themselves. With regard to the 88 more necessitous cases, we are of the opinion that a separate villa should be provided for those patients who, from the fact that they are confined to their rooms, require more quiet. A villa of this kind is being provided at Linford and other sanatoriums. The more serious cases should be housed here, whilst it is often a good plan to take new patients into what we may term the hospital block and then, after the individual peculiarities of the case have been thoroughly grasped by sufficient observation and the patients are sufficiently well, to draft them on to other houses. The men and women who are not confined to a sick house like this should, as we have pointed out, be placed in separate blocks. The number of the patients in each house of this kind depends both on the nature of the cases treated and on the amount of money to be expended on the building and the service. We would suggest, however, that the hospital block should find accommodation for 16 patients. At the Nordrach Colonie, where all stages of the disease are treated and where there are now some 70 cases, from 10 to 12 cases are usually confined to their rooms; and at Nordrach no particular provision is made for surgical cases. We would also suggest that one block should provide accommodation for 36 men and another for 36 women.

THE ASPECTS AND POSITION OF THE VARIOUS BUILDINGS.

Aspect.—It is shown by Appendix No. X., page 34, and especially by results obtained by the Nordrach Colonie, that the mere aspect of a patient's bedroom has no marked effect on the results of treatment at an efficient sanatorium. There can, however, be little doubt that for patients who are confined to their own rooms, as many must be from time to time, it is advisable from the point of view of their comfort, that the buildings should be so placed that they take advantage of the rays of the sun, which are grateful to the patients and are nature's best disinfectant. Again, the aspect must be such that the bedrooms are as much sheltered from strong winds as the nature of the site allows. It is, however, a mistake to place a building in such a sheltered position that no movement of air occurs, for it is on the free circulation of the air that we must rely for the purity of our atmosphere. In order to obtain abundant light the main front of the building should be south, south-south-east or south-south-west. A directly south aspect is not so good in summer, as the rays of the sun stream directly into the patients' bedrooms and are apt to cause these to become unpleasantly hot. These effects can be avoided by removing the patients to northern bay-windows, or to open-air galleries, such as we have provided, but Demany and Jorisenne have shown that in a climate such as England's the best aspect for the main front of the buildings is S.S.W. or S.S.E., provided that there is no very high hill in the neighbourhood to cut off the light. With both a S.S.E. and a S.S.W. aspect the sun will shine mainly on the roof in summer, and into the patients' bedrooms in winter. Another consideration, in connexion with this question, is the direction of the prevailing winds. This must depend largely on the character of any particular site, but as a rule, in England it is most serviceable in the treatment of tuberculosis to have protection against the northerly and easterly winds; consequently we have designed the individual blocks in such a way that they consist of a central portion with two wings drawn at an angle of 145°. The central portion contains an open-air gallery and looks directly south; one wing faces S.S.W. the others S.S.E. In this way the greatest advantage is taken of the sun-shine on the northern as well as on the southern aspect, whilst the two wings and their sanitary towers tend to shelter each other from the effect of the wind. The aspect of the bedrooms in 72 sanatoriums is given in Appendix No. XI., page 34. It is at once clear, from what has already been said, that the engine-house should be well removed from the sanatorium proper, both on account of the noise it creates and of the possibility of dust.

FIG. 1.



Block plan.

Position.—The separate blocks must be as far as possible removed from all other sources of noise, and must further be so placed that the ground in front of the main aspect is well cleared, so that a free circulation of air is permitted and the patients are able to enjoy the view. Again, in the immediate vicinity there must be a sufficient number of trees to afford adequate shelter to those patients who are restricted to a small amount of exercise. The maintenance block must not be placed in such a position that any fatigue is experienced by even feeble patients on their way to it from their own rooms; it should be placed at a *slightly* higher level than the others so that no smell of cooking, dust, and the like is carried from it to the smaller buildings. This position also serves the purpose of not interfering with the view of the patients or with the free circulation of air in front of the individual rooms. The exact position of the various buildings must depend on the individual site, but care must be taken that they are placed in such a position that patients never have to descend from the sanatorium buildings to ground at a lower level. A general view of the aspect and position of the buildings proposed may be seen from Fig. 1.

GENERAL DETAILS OF CONSTRUCTION.

General considerations.—Our aim is to construct a building which shall meet the requirements laid down, but we

must at the same time strive to make the ensemble as attractive and cheerful as possible and avoid the dreariness inseparable from a hospital. The main considerations which, as we have seen, should guide us in the construction of our buildings are that every part must be well ventilated and capable of being easily flushed with a continuous supply of fresh air, readily cleaned, and freely open to the sunshine. It has been found by experience that a building can only be sufficiently flushed with air for sanatorium treatment when the rooms are set in a single row with a corridor, which looks on to the open, running behind. A window of this corridor must be opposite every bedroom door, and the corridor itself must be capable of having a straight flush through by means of doors or windows at either end.

Number of storeys.—The number of storeys should not be greater than two, as higher buildings than this entail too much service, whilst sanatorium patients are not capable of climbing many stairs, as we can readily understand when we reflect on the fact that in raising the body vertically an amount of work is done which is equal to that expended in moving the body 20 times the distance on level ground. In other words a climb of 60 feet or five storeys equals a walk of 1200 feet along level ground. Single-storeyed buildings add very much to the expense owing to the necessary foundations, whilst they are not the class of building to which our patients must return when they resume their ordinary occupations. The number of storeys in 89 sanatoriums is shown in tabulated form in Appendix No. IX., page 33.

Avoidance of noise.—One most important point in construction is the necessity of adopting every precaution to diminish noise. A sanatorium is like a sounding box, for it is devoid of all carpets and nearly all hangings which can lessen the conduction of noise, and unless some precautions are adopted, as any one with any experience of sanatoriums knows, the nuisance created is a very real one. Many precautions have been tried, such as 15-inch brick partitions, double partitions with the space between filled in with various materials, three layers of gypsdielen and two air spaces between the floors as at Hohenhonnef, double doors and the like. With open windows the conduction of sound can never be altogether prevented, but we consider that the difficulty is best surmounted by building all internal floors of steel girders laid on felt and filled in with concrete, the internal partitions being made of cement. This method of construction reduces the sound and is very light. The chief noise is generated in the corridors, and these should have cork carpets, which may be varnished from time to time, laid on cement. As little wood should be used as possible in construction, owing to the necessity of providing against any danger from fire.

Roof.—The roof should be flat and asphalted, as roofs of this kind avoid the usual dust-collecting space between the slates and ceiling, which can never be cleaned. Again, when repairs are necessary they can readily be done from boats hung from the parapets without the erection of any scaffolding. Such flat roofs may be utilised by certain of the patients and afford a good vantage point for overlooking the grounds; they do not increase the heat of the rooms in summer or add to their coldness in winter, whilst they do not permit the noise of wind or rain to be transmitted if the necessary precautions are taken.

Ground floor.—The rooms on the ground floor should be raised about four feet above the ground on the higher side, to ensure the privacy of the bedrooms. In several sanatoriums where the ground floors are on the same level as the ground there is no privacy and the comfort of the patients is considerably curtailed. By raising the rooms four feet a thoroughly dry building is obtained, together with a few rooms in the basement for stores, boots, and the like, on the lower portion of the building. Provided that these basement rooms are thoroughly dry they are not objectionable in any way so long as they do not communicate with the shaft of the main staircase and so cause a draught.

Foundations.—The foundations should be of cement concrete, the depth, &c., being decided when the site is chosen. Damp-courses should be provided of slate and cement and the ground in the neighbourhood should be efficiently drained of surface water.

Lining of walls.—The character of the lining of the walls depends very largely on the amount of money at command. We have considered this question in greater detail in connexion with the description of the patients' bedrooms and need only say here that we would advise that the floors be made of teak, with the joints well plugged and laid on cement, as this tends to make the building fireproof and at the same time soundproof. All walls and partitions should be lined to a height of three feet six inches, or in the case of certain rooms, such as the kitchen and larder, up to the ceiling, with glazed tile work, and above this should be oil painted or, in the case of the well-to-do block, papered with washable paper.

Lodgment for dust to be avoided.—Where there is any right-angled junction, such as exists between the floor and the wall, the angles are to be rounded. There must be no right angles in anything, not even in the joinery work, whilst no moulded or projecting architraves should be used unless they have plain rounded surfaces, so that no lodgment for dust may exist.

Ceilings.—We would also advise that the ordinary type of ceiling, with its dirt-accumulating space underneath the joists, be not used, but that a zinc ceiling be placed directly on the under sides of the girders and fixed on a cement bed and the zinc then painted. There are several materials on the market, such as mezzotile, which answer this purpose admirably. The whole ceiling can then be readily cleaned at the same time as the walls in a very short space of time.

Stairs.—The stairs should be made of teak and all angles should be rounded so that they may be readily cleaned. At the London Open-air Sanatorium the staircases are built with an open space between the tread and the rise and between the stairs and the wall. A greater surface is exposed in this way to the dust and this surface is not so readily cleaned as a rounded angle; in fact, when a stair is cleaned the dust tends to be carried through the spaces to the floor below.

Windows.—All windows should be carried flush with the ceiling and so constructed that they are opened without effort and do not clatter in the wind. The glass of these windows should be free from ornamentation or dust-collecting ledges and should be plate-glass.

Precautions against fire.—In addition to the foregoing the separate blocks for the patients will have at either end of the second floor an iron bridge leading directly back to the sloping hill on which they are built. Fire-cocks will be placed, together with the necessary hose and hydrant, in convenient places in all the buildings. The value of these necessary precautions is considerably increased if the staff of the establishment is suitably trained by the regular fire drills which are carried out in the more efficient sanatoriums.

THE PERSONNEL.

It is necessary to consider this question briefly in order that we may be in a position to determine the necessary accommodation.

Medical men.—With regard to the number of medical men it has been found by experience that no medical officer can properly supervise more than between 30 or 40 patients on the lines adopted in efficient sanatoriums. Consequently, in addition to the medical superintendent, who should have supreme control, at least two other medical men will be required for 100 tuberculous patients. As, however, during three months of the year one or other of these will be away on leave it is advisable, apart from the possibilities of sickness and from the fact that the 12 well-to-do people may require more attention, to have a fourth junior medical man to assist when required and to carry out the ordinary routine laboratory and record work. The medical men who have charge of the patients will not be able, according to our experience, to devote much time to research work. As research is to be a feature of the sanatorium it will be necessary to follow Brehmer's example and have at least one specialist in scientific research resident in the sanatorium. We have accordingly provided in the administration block for four medical men and one research director, giving them a bedroom and sitting-room each, together with a billiard-room. These rooms (see Figs. 8 and 9, pages 23 and 24) are cut off from the rest of the building, conveniently placed for the purposes of supervision and in the vicinity of the special departments. If one of the doctors marry or is married it is best that he should be provided with a separate house; whilst anyone who may be working in the research laboratories can easily find accommodation in a neighbouring village. The medical men should dine with the patients, and so a separate dining-room is not provided for them; on special occasions, such as Sunday evening, when it is not unusual in sanatoriums to relax the strictness of the discipline, they can dine in the committee-room.

Nurses.—The number of nurses required depends largely

on the character of the cases admitted. Severe cases and well-to-do people require a larger number than early cases among a more necessitous class. At the proposed sanatorium in connexion with the Brompton Hospital six nurses will be provided for 100 patients, most of whom will be in an early stage of the disease. As we take it for granted that cases in all suitable stages of the disease will be treated at His Majesty's Sanatorium, and as 12 well-to-do patients have to be provided for, we have decided to find accommodation for 10 nurses. Two of these will reside in the well-to-do block, one on either floor, and two in the sick block, whilst accommodation is found in the maintenance block for six. Nurses can do much for the comfort of the patients, not only when the latter are confined for any reason to their own rooms, but especially when they first arrive at the sanatorium; whilst, by dining and taking exercise with the convalescent cases, the nurses can ensure the necessary discipline being maintained. They can, in addition, relieve the servants of a considerable amount of work. If at any time more nurses are required for special reasons they can readily be procured.

Other members of the personnel.—In Appendix No. VI., page 32, we have given details of the *personnel* provided at some of the sanatoriums for 100 or more patients. We are of opinion that it is the best plan for many of the staff—such as the clerk, the gardener, the servants who clean out the patients' rooms, and others—to reside in the neighbouring cottages. This is already the practice at many sanatoriums, as, for example, at Sülzhayn. Accordingly, we have only provided accommodation, so far as the 88 necessitous cases are concerned, for a secretary, a matron, a cook, 10 female servants, and five male attendants. All these will have their rooms in the administration block with the exception of two of the male attendants who will sleep in the 36 male block and so be ready to call a nurse or medical man in case of emergency, and two of the female servants who for similar reasons will sleep in the 36 female block. Accommodation is also found for an engineer in the engine-house.

Staff for patients with more ample means.—The block for the patients with more ample means must have a separate staff. It is difficult to come to any decision as to the number and character of the staff for this block without knowing exactly the class of patient expected, but we have tentatively allowed for a superintendent or housekeeper, a cook, six female servants, and four male attendants.

No accommodation is provided for any patients' private servants, as all sanatorium authorities are agreed that these do much to upset the discipline and that they sometimes do harm by smuggling in alcohol and certain luxuries of doubtful advantage.

THE PATIENTS' BEDROOMS.

As we have seen it is of primary importance that the patients' bedrooms should be easily flushed with air so as to maintain the requisite standard of purity and be capable of being readily ventilated from several quarters and readily cleansed.

Cubic capacity.—With regard to the cubic capacity it is obvious that the standards drawn up for rooms with closed windows do not apply in the case of an open air sanatorium. The cubic space is of less importance than the size and position of the ventilating openings. Within certain limits, the larger these openings are the better, so that a free circulation of air may take place without causing a draught, or encouraging what has been called the hurricane treatment. It has been said that the bedroom should be as small as possible, as it should only be used as a shelter for the bed and as a dressing-room. We have seen, however, that many patients must be confined to their rooms for considerable periods of time, so that their comfort in this matter must be considered. Again, if a room has the windows open constantly it becomes to all intent and purposes a shaft, and it is well known that the smaller the shaft the more liability there is to draught, and this is well exemplified in several sanatoriums where the bedrooms have been made too small. A further objection to small rooms is the greater proportion of space taken up by the furniture and the consequent difficulty in moving about. It will be seen further from Appendix No. XII., page 34, that in many sanatoriums the bedrooms have a cubic capacity of 1500-3000 feet.

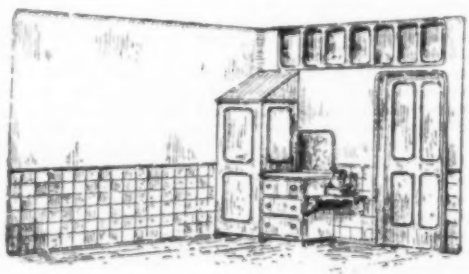
Height.—There is no advantage in having the rooms higher than 10 feet, although the old arguments about the air of rooms being stagnant above a level of 11 feet do not apply to a room in which the windows are flush with the ceiling and are kept constantly open. If the room is higher than 10 feet it is more difficult to clean it methodically, whilst the windows tend to become unmanageable. It will be seen from Appendix No. XIII., page 34, that the height of the bedrooms in various sanatoriums varies from 8½ feet to 14¼ feet.

Floor space.—The floor space must be sufficiently large to permit of the position of the bed being changed if necessary and of the furniture being freely moved for cleaning purposes, because the air is always more or less stagnant under beds and under articles of furniture, as is shown by the great tendency of dust and fluff to collect in these positions. A floor space of 10 feet by 12 feet, according to our experience of several sanatoriums where this exists, is too small for comfort and not large enough to allow the furniture to be readily moved. The floor space allowed in a number of sanatoriums is given in Appendix No. XIV., page 34. The depth measured from north to south of a room in a sanatorium with windows only on the south side should not be more than 12 feet on account of the necessary sunlight; when, however, fanlights are placed along the north wall the depth may safely be 14 feet.

General dimensions of rooms.—We have decided from the above considerations to make the individual bedrooms 10 feet high 12 feet broad, and 14 feet deep, giving a cubic capacity of 1680 feet, or when the bay window, which we shall presently describe, is taken into account, 1960 feet. The depth rather than the breadth is 14 feet, as in this way the length of the building is diminished.

The ventilation.—The general method of ventilation of the various buildings is considered in a separate section, but we may say here that the ventilation of the bedrooms will be carried out by means of open windows and fanlights. In addition each room will be fitted with an electric fan for use in hot weather, together with an upcast shaft, with mica flap to prevent down draught, which will be placed near the ceiling. The windows on the south will be placed two feet six inches from the floor, so that the patients when confined to bed may have an uninterrupted view, whilst those on the ground floor—raised three feet above the ground level—will not have their rooms overlooked by passers-by. These windows will be four feet nine inches high and above them will be fanlights two feet high. The latter will finish flush with the ceiling and open outwards; they will also be hung from the top so that the room may ventilate into the air outside and protection may be obtained against rain.

FIG. 2.

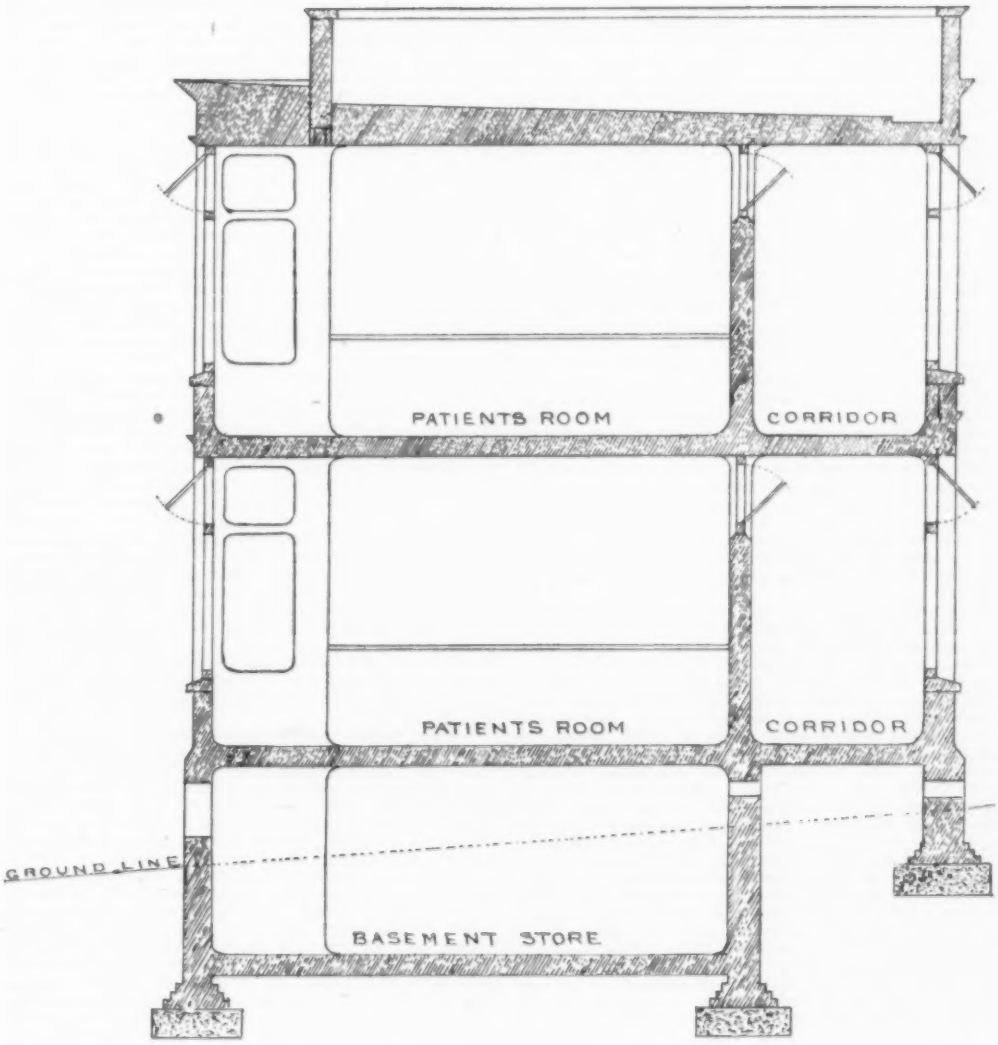


Perspective view of a patient's room.

North aspect of room.—Along the whole length of the northern side are fanlights 2 feet deep and 10 feet wide, which are flush with the ceiling and open outwards on to the corridor on a hinge at their lower part, so that the room ventilates into the corridor. (See Figs. 2 and 3.) The door is three feet six inches wide, in order that the bed may be readily wheeled out and is placed opposite a casement window in the corridor.

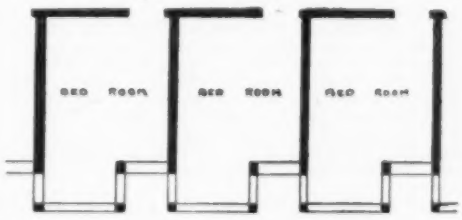
South aspect.—On the western half of the south aspect of the room and immediately opposite the door is a casement window and fanlight three feet six inches broad. On the eastern extremity of the south side is a square projection (see Figs. 3 and 4, page 17) seven feet long by four feet deep. The northern side of this projection is open to the room, but all other aspects of it are inclosed by windows, such as those described, one casement looking east, one west, and

FIG. 3.



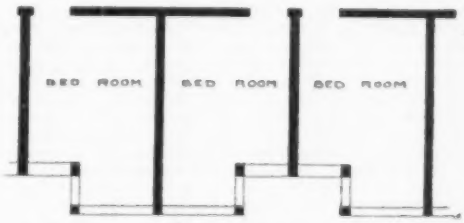
Transverse section of block for 36 patients.

FIG. 4.



Plan of bedrooms showing window projections. (Scale—one-sixteenth of an inch to the foot.)

FIG. 5.



Plan of bedrooms showing two window projections thrown into one. (Scale—one-sixteenth of an inch to the foot.)

two in a southerly direction. This projection affords ample space for a sofa chair and in our opinion is an ideal place for those patients who may be isolated and confined to bed and for all patients during the hour they are resting before the midday and evening meal. In addition, it affords a ready means of acclimatising patients, especially the more elderly, to an open air life. No matter what wind blows the window on one or other aspect can be opened without harm, whilst, when the patient rests in this part of the room, the other portion can be flushed out by a direct draught between the western (or eastern) window and the door. In our opinion, these projections afford the most efficient means by which a patient, when in his room, may enjoy a free circulation of air and yet be protected from the weather; they will be five feet apart and no patient, although able to see from one projection to another, will be able to overlook the interior of the neighbouring rooms to any appreciable extent. Naturally, they add somewhat to the cost of construction; if the amount of money at command is limited two projections may be thrown into one, so that one loses its eastern and the other its western aspect (see Fig. 5). If the projection thus curtailed is still too costly we must revert to straight walls and depend on the ordinary windows for the necessary free circulation of air.

Protection against rain and sun.—In most sanatoriums some provision is made against wind, sun, and excessive rain in the bedrooms and elsewhere by means of screens, which are also of service in the case of patients who cannot sleep unless the room is darkened. Schrader discarded venetian blinds as they collected dust and were unsuitable, and the same objection holds good of various forms of storm shutter. We would recommend roller blinds such as are used in shops, of greenhouse shading, a material which prevents the entrance of excessive rain and serves to check the too rapid passage of air although it allows free ventilation. This material can readily be removed, cleaned and disinfected.

Lining of the walls.—The chief considerations to be kept in view when choosing the material for lining the walls are that it should be readily cleaned without entailing much service and that it should not be depressing in character. The walls of the patients' rooms are not very liable to infection in a building where the patients are carefully trained to dispose of their sputum, but the fact remains that by carelessness or accident the walls may be infected. As we have seen, numerous researches on this point have been carried out, but practically all agree with Coates, who has shown that when the walls are infected with sputum it is nearly always within one or two feet of the floor. This is an important observation as it shows the necessity of providing an easily cleansible lining material in the immediate neighbourhood of the floor. Various materials are employed in existing sanatoriums —tiles, oil-paint, ordinary distemper, washable distemper, duresco, petrifying fluid, wood, and various forms of paper, such as ordinary paper, washable linen paper, and washable muraline paper with a canvas backing. Wood is apt to crack and the joints to harbour dust, whilst it is difficult to join thick paper in a satisfactory manner. There are, however, many materials adapted to our purpose and the question of what lining should be used depends largely on the amount of available money. Some forms are cheaper in their initial cost, but require to be renewed at frequent intervals. There can be no doubt that the form of wall-lining which is most readily kept clean and entails the least service is tiling efficiently laid. There are many forms of artistic tiling on the market which do not make a room look cold and although the initial cost is greater than of some other forms of wall-lining yet tiling lasts better than any other material. We therefore advise that the walls of the rooms should be lined with glazed tiles to a height of three feet six inches—that is, to the height of an ordinary chair. About one inch below the top line of the tiling a small well-rounded projection may be allowed, as this gives a finish and prevents scraping of the lining material above when the upper portion of the tiles are cleaned. We should recommend oil-painting as the most satisfactory lining above the tiles, unless there is sufficient money at disposal—as, for instance, in the case of the well-to-do block—to provide for the more frequent renewal of washable papers, which do much to add to the cheefulness of the room. The colour of the tiling should be varied in the different rooms in order to avoid any monotonous effect.

Ceiling.—We have already dealt with the character of the necessary ceiling in the section on structural details.

The floor covering.—A large number of materials are used in sanatoriums in the construction of the floors, such as wood, which may be hardened and polished by a mixture of paraffin and benzine, various forms of tiling and terazzo, fossil wood or xylolith, linoleum, cork carpet, which may be varnished, torgament, a cement which unites with wood or iron and has incorporated with it wood shavings, so that it is both cleanly and warm to the feet, and gypsdielen, which is usually covered with linoleum or parquet and consists of bamboo incorporated with plaster-of-Paris. Linoleum is the cheapest of these, but we have never seen it in use without noticing a number of cracks, to say nothing of the dust which collects at the margin near the wall. Again, condensation always occurs beneath linoleum and is one of the commonest causes of dry rot; the placing of felt beneath the linoleum does not diminish either this or the collection of dust. We consider that of the hard coverings a teak floor laid on cement gives the most satisfactory results and lasts better than any other material. At the junction of the floor and walls there must be a bold curve in the tiling, so that dust may readily be removed, and furniture, such as the bed, may not abut on the walls, and so interfere with the free circulation of air.

General requirements of the furniture and hangings.—The furniture must be light, and free from unnecessary ornamentation, mouldings, or dead space. It is important that it should be readily cleaned, and that the under surface of any article should not escape this process. It should be smart in appearance, for smartness leads to cleanliness. The bed should have rubber castors, and the legs of other furniture should be capped with rubber as this prevents the floor from being marked, and does away with much noise. There is no absolute necessity for a carpet provided suitable slippers are used, but one small mat of cane or other readily disinfected material conduces to comfort whilst dressing. The hangings must be simple and readily washed. Pictures add to the cheerfulness of rooms, but they also add to the service as they must be kept free from dust, and consequently, although they may be permitted in the recreation and dining-rooms, they should not be allowed in the bedrooms, unless an ample staff can be provided, or there is sufficient money at command to arrange for their being let in flush with the walls.

Whether wardrobes and cupboards should be provided.—It is undesirable to have bags and boxes in the bedrooms, so that some form of receptacle must be provided. Chests of drawers probably meet all requirements, but it is usual in sanatoriums to have either a cupboard or a wardrobe; the former are more expensive as regards construction, but they encroach less on the cubic space of the room: both are open to the objection that they are not readily cleaned.

Other necessary articles of furniture.—We suggest that in addition to a bed, two small chairs, a sofa chair in the bay window, and a bed table with glass or marble top, a special piece of furniture should be provided. This latter may consist (see Fig. 2, page 16) of a hanging cupboard for clothes, a chest of drawers and a washstand combined, together with a fixed plate of glass, as swing or hanging glasses tend to collect dust. It should be built on rubber castors, so that it may be easily moved every day and the whole readily cleansed. We would advise that neither the cupboards nor the drawers have any back so that they can be readily cleaned out. The top of the cupboard should be sloping, all angles rounded off, and there should be no moulding or other ornamentation which would serve as a lodgment for dust.

Whether douches or lavatory basins be placed in these rooms?—In some sanatoriums, such as Nordrach, each room is provided with a douche and with two fixed lavatory basins, the one being for use when washing the mouth and teeth. The presence of a douche in the room is an extremely convenient arrangement, occupies little space, and involves the minimum of strain on the patient, but English sanitary authorities almost unanimously condemn it, more especially when there is not the high water pressure of Nordrach on the ground that the pipes and traps become almost as foul as soil pipes. In view of this we have arranged the bath-rooms in the sanitary tower which we shall presently describe.

Method of lighting.—The rooms will be lighted by electric lamps, one of which will be placed over the washhand stand and controlled from the door, whilst the other will be

attached to a wire so that it can be used in any part of the room.

Means of communication.—The electric bells, one placed near the door and the other on a length of wire, so as to be available at the bed or sofa chair, will be arranged so that a nurse may be summoned at once by day or night.

It will be seen from the plans that recesses are provided in the corridors, with a northern aspect, to which those patients who are isolated may retire when their rooms become uncomfortably hot in summer.

THE VENTILATION ARRANGEMENTS.

We have shown in the previous pages that the ventilation of the buildings should be such that the air within them constantly rivals the outside air in point of purity. This is a higher standard than the one adopted by most sanitary authorities for ordinary buildings on the basis of Parkes's work. Most authorities accept as a standard of purity a percentage of 0·06 of carbonic dioxide. This is too high a percentage for tuberculous patients, and Rufenacht Walters, in a paper read at the recent London Congress on Tuberculosis, showed that it was possible to keep the percentage of carbon dioxide in a sanatorium bedroom inhabited for many days by a feverish patient almost as low as that of the outside air. The rules for good ventilation as laid down by many authorities nearly all apply to rooms with closed windows. When the windows are kept constantly open ventilation is much easier, more especially when by means of an open door and fanlights on the wall opposite the windows a through ventilation is obtained. The inlet must be sufficiently large to prevent a draught, for air, like water, tends to rush through a small opening and so cause a draught, whilst with the same pressure it will pass quietly through a larger opening.

Appendix No. XVI., page 35, gives a tabulated statement of the various forms of ventilation used in 76 sanatoriums and it will be seen that some trust entirely to open windows with or without fanlights on the opposite wall, others to open windows with various forms of ventilating inlets or shafts, and others to open windows with cold or warm air forced in, whilst a few utilise open fires or chimneys in addition to the open windows. We may say at once that the plenum system must be condemned; it was tried at Nordrach, at the Ventnor Hospital, at the National Consumption Hospital, Ireland, and at the Forster Green Sanatorium, and in all cases given up as useless. We have said enough, in previous pages, to show that no system of forcing heated air into the rooms is good. Open-air fires are most useful ventilators in ordinary houses, but as may be seen from the Appendix No. XVII. (*a*), page 35, in which we discuss the relative value of various methods of heating, they are not of service in sanatoriums. They give rise to dust both when burning and when being cleaned, and on this count alone must be condemned; again, when the windows are widely open sudden gusts not infrequently blow the smoke into the room and give rise to draughts. We have therefore decided to ventilate the patients' bedrooms in the manner already described in the account of these rooms. The larger rooms and any part of the building where air is likely to become stagnant or foul will be ventilated by electric fans and shafts in addition to open windows. In summer time the doors of the bedrooms, which are placed opposite a corridor window, may be opened and the passage of air from the cooler side of the house facilitated.

HEATING AND COOKING ARRANGEMENTS.

In the earlier pages we showed that in constructing a sanatorium every means must be taken against the formation of dust and that the use of coal should be avoided as far as possible. The only way in which the use of coal can be completely avoided is by means of electricity, generated by water power or by means of oil or gas engines. At many sanatoriums coal is not used in the patients' quarters but is employed in the engine-house for the purpose of generating electricity. In such cases dust must always be discharged into the atmosphere, and in our visits to some of these sanatoriums we have never failed to obtain evidence of the presence of a large amount of dust in the atmosphere by the simple expedient of running our fingers over various articles in the patients' rooms. In our opinion electricity should be employed as much as possible in all sanatoriums. The way in which the electricity is generated must depend on the natural advantages of the site. A sufficiently abundant water-supply affords an ideal means, but failing this we must have resource to oil or some form of gas. The use, however, of electricity generated by oil on a large scale is expensive. If gas is utilised it may be taken from the ordinary mains when these are available, but otherwise one of the forms of gas which can be made without the use of coal should be manufactured at some little distance from the sanatorium buildings. Electricity can be economically employed not only for warming the patients' rooms but for laundry purposes and for cooking. We show in the specification on this subject (see Appendix XVII. (*b*), page 36) the use we propose to make of this means of heating. As it is not conducive to economy to heat the water required for the steam disinfector or for baths, lavatories, or laundry purposes by means of electricity we propose to use small upright boilers for this purpose. These boilers will be supplied with coke and will have efficient smoke consumers attached to them. In the case of the patients' blocks they will be placed in the basement under the sanitary towers, with a shaft carried up the towers well above the level of the roof, whilst the necessary flow and return pipes and draw-offs will be confined to the towers as far as possible. The bedrooms of the patients do not require any artificial warming for many months in the year, and when such artificial warming is used we have shown that the temperature of the rooms should not be much higher than that of the outside air. At the same time, if the temperature of the rooms is a little higher than the outside air much is done to ensure good ventilation. As may be seen from Appendix No. XVII. (*c*), page 37, on this subject the temperature of the rooms at many sanatoriums, such as Rudgwick and Rossclare, is the same as that of the outside air in the winter, no artificial heating being used at all. In other institutions, such as Linford, the Grampians, Adirondack, and Boserup, the temperature is never allowed to exceed 50° F.

The small increase of temperature required is readily given by many of the electric radiators on the market and in this way we avoid a considerable amount of initial expense in the matter of pipes, &c., whilst the annual cost of maintenance, redecoration, and service is also much less than in the case of any hot-water or steam system. Electric heating is used in some rooms at Nordrach-on-Dee and in one villa at the Nordrach Colonie and in both cases gives satisfactory results; it is also to be installed in the proposed sanatorium at Liverpool. The position of the radiator is of importance, for no attempt should be made to warm the incoming air, as this interferes with its humidity and destroys the ozone and the attempt ends in failure where open windows are used.

We show in Appendix No. XVII., page 35, the various forms of heating apparatus used in over 100 sanatoriums, and in Appendix No. XVII. (*a*), page 35, discuss the advantages and disadvantages of the various methods used. In some sanatoriums open fires are provided for the staff although the patients are not allowed to have them. There is no reason why the staff should have open fires; their absence cannot be regarded as a hardship seeing that to all intents and purposes they are not used in any country except England. In those sanatoriums in which an exception is made, and the staff are allowed coal fires, we have noticed that dust collects in considerable quantities. Finally, in most sanatoriums as time goes on a large proportion of the staff consists of former patients who are better without open fires.

THE LIGHTING ARRANGEMENTS.

There is no doubt that electricity affords the ideal means of lighting in any building which is specially devised for the reception of people in ill-health. It gives a most efficient light, does not the over-heat the rooms, and does not lead to the formation of noxious products in the air, whilst it is easily regulated, always available, and saves much expense in the way of redecoration. All rooms in the proposed sanatorium will be fitted with electric light, together with some of the shelters and the covered way. The lights will be suitably placed for the varying requirements of the rooms and passages, whilst the greater number in passages, corridors, &c., but not in the patients' bedrooms, will be controlled from the central station, so that, for the sake of economy, they may be simultaneously turned off at certain hours, only sufficient light being left in the corridors and other places for special emergencies.

GENERAL DINING AND KITCHEN ARRANGEMENTS.

As the well-to-do patients will necessarily expect superior arrangements and a better cuisine their block is provided

with a separate kitchen and and dining room. We need only mention here that both the dining rooms and the kitchen premises in this block are entirely cut off from the patients' rooms by cross-aerial ventilation. With regard to the dining room and kitchen accomodation for the more necessitous cases we have already shown that they must be completely cut off from the patients' bedrooms, and Appendix No. VIII., page 33, shows that this is done at a number of existing sanatoriums. We find that at the Royal National Hospital at Ventnor and elsewhere the provision of a dining room and kitchen for each separate block has proved wasteful and therefore we have provided (see Fig. 8, page 23) one dining room and kitchen in the administration block for all those patients who are able to take exercise. These premises are cut off by efficient ventilation from the other portions of the block, and, as will be seen, there are arrangements by means of suitable doors for completely cutting off the corridor which runs behind the dining-room and in front of the part of the building which contains the kitchen and other offices from the rest of the building when meals are being served.

The patients who are confined to bed are better without any kitchen in the vicinity, as it is difficult to control the ventilation effectually and to keep the air pure; consequently their food is to be cooked in the administration building and then transferred by means of Swedish cars to the various blocks. That Swedish cars effectually keep the food hot and do not lessen its palatability at all, is shown by the fact that many people in London and elsewhere patronise them for dinner parties and other entertainments, whilst cars of very similar construction are frequently used in shooting parties to provide a hot luncheon. Patients in bed will further require their food to be served on hot-water plates, as they often spend some little time in negotiating a meal. We have considered whether the food could be conveyed from one building to another by means of a pneumatic tube or railway contrivance, but the estimate given by the engineers whom we consulted shows that the cost would be prohibitive, and, indeed, there is no occasion for anything of this kind as the Swedish cars meet all the necessary requirements.

THE DRAINAGE ARRANGEMENTS.

Disposal of sewage.—Whether we dispose of the sewage conservancy methods, by the water-carriage system, or by some form of tank treatment must depend to a very large extent on the character of the ground on which the sanatorium is built and upon the facilities afforded in the neighbourhood. We will, however, mention some of the arguments for and against these various systems. All sanitary authorities are agreed that the best conservancy system available is the one which employs earth closets. This system has been adopted in several modern sanatoriums, such as the East Anglian, and there can be no doubt that it is a very good one from a sanitary point of view, for the reasons that it does away with all pipes and with the possibility of leakage and that there is no delay in the disposal of the excreta. Vivian Poore has shown, further, that it is of value for various agricultural and financial reasons, whilst closets with automatic arrangements for supplying the necessary earth which are easily worked, practical in construction, and not liable to disarrangement, are on the market. Lortet and Despeignes have shown, however, that the earth-worm brings tubercle bacilli to the surface and that these may be a source of infection and Galtier of Lyons has proved that the bacilli may resist putrefaction in earth for months. Gärtner buried the bacilli for one year and found that they remained virulent, whilst Shottlius claims that they remain virulent for as long as two years. Again, Biggs of New York and Flick of Philadelphia have shown that the soil on which houses inhabited by consumptive individuals have stood has become infected. This difficulty might be overcome by freely exposing the excreta to sunshine for several days before digging in or possibly by the addition of disinfectants, but both these methods are open to practical objections. Further, the earth-closet system is open to the following objections: it requires a special form of soil; the cost of the cartage and the supply of suitable earth, of preparing the same by suitable drying and passing through sieves, and of providing men to carry earth and to empty the pails is considerable, apart from the cost of the kind of land necessary for distribution, whilst a nuisance may be readily created, more especially if it is used on any storey above the ground floor.

We advise, then, that the earth-closet system should not be adopted. We consider that the water-carriage system, if a sewer is available in the neighbourhood, is the best method we have for disposing of the sewage, as by this means the sewage is kept moist and the tubercle bacilli are gradually destroyed by other micro-organisms, while there is no danger of any escape of the putrefactive gases provided that the necessary work is efficiently carried out. In Appendix No. XIX., page 40, we have given an expert's specification for the installation of this system in connexion with the buildings. If the water-carriage system is not available we recommend the adoption of the biological process of Cameron, which, as we have shown in Appendix No. XIX. (*a*), page 41, is the best of the tank methods.

Disposal of slop water.—In the country it is desirable that the slop water should be turned on to the land in some form or other, more especially if the biological method of disposing of the sewage is adopted, as it not infrequently interferes with the efficient working of this process. We recommend the adoption of Kenwood's system of sub-irrigation, which, as we have shown in Appendix No. XIX. (*b*), page 42, is the best method for disposing of slop water. The waste from the kitchen and pantry sinks must be efficiently strained and filtered.

THE LAVATORY, BATH-ROOM, AND WATER-CLOSET ACCOMMODATION.

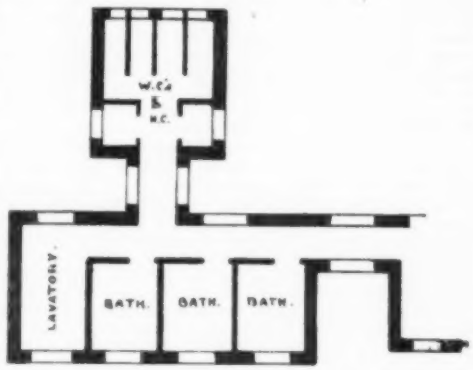
General fittings.—All sanitary fittings, as may be seen from the specification given in Appendix No. XIX., page 40, will be of the most modern type.

Urinals.—No urinals will be provided in any part of the sanatorium as these are filthy contrivances at best and there is no necessity for them where lift-up water-closet seats are employed.

Administration block.—In the administration block (see Fig. 8, page 23) a male and a female lavatory are provided for the patients in the immediate vicinity of the entrance-hall, together with water-closet accommodation which is well cut off from the lavatory by cross aerial ventilation. As may be seen from Figs. 8 and 9, pages 23 and 24, the necessary sanitary accommodation for the *personnel* is thoroughly cut off from the patients' rooms and conveniently arranged as follows: two water closets, two bathrooms, and a lavatory for the medical staff, a separate closet and bathroom for the secretary, a separate closet and bathroom for the matron, two closets and two bathrooms for the nurses, two closets and one bathroom for the female servants, together with two closets and one bathroom for the male servants.

Sanitary towers in patients' blocks.—With regard to the patients' blocks, the sanitary arrangements are grouped together in sanitary towers. The position of these towers is a matter of importance. Wherever possible they should be

FIG. 6.



Sanitary tower. (Scale—one-twentieth of an inch to the foot.)

placed at the end of the building as they afford considerable shelter in this position to a house which consists of two wings joined at an angle of 145°, and are less likely to ventilate into the corridors or bedrooms than if they were

placed, as they are in some sanatoriums, at the back of the corridor. Therefore these sanitary towers should be placed at either end of the sick house and of the house for the well-to-do patients. Whether the towers can be placed at the ends of the blocks for 36 patients depends on the character of the case treated, but as patients in these blocks will be in a convalescent stage the extra length of corridor which must be traversed in going to the bathrooms or elsewhere is not a great disadvantage.

The accompanying plan (Fig. 6, page 20) shows the way in which these towers are cut off from the rest of the buildings and the manner in which the accommodation is distributed. All portions of them will be ventilated by open windows and by extractor fans. In the blocks for 36 patients there will be on each floor of a sanitary tower three bath-rooms and four water closets in addition to a lavatory and housemaid sink accommodation. In the block for the severer cases two water closets and two bath-rooms are provided on each floor of the sanitary towers, together with lavatory and other accommodation. In the block for the well-to-do ample provision is made for the patients and for the staff. Each lavatory in the separate houses can be used as a hair-cutting room, and in view of the fact that hair cutting causes much dust (so much so that the trade of hairdresser stands high in the mortality-rate of tuberculosis) special ventilation of these rooms will be provided.

THE MEASURES WHICH SHOULD BE TAKEN TO DESTROY THE TUBERCLE BACILLI.

It is necessary to consider this part of the subject in order that we may decide what constructive details have to be provided with regard to disinfection. We have shown that tuberculous individuals may readily spread virulent bacilli, but that if reasonable precautions are adopted this danger may be avoided. Thus Achtermann, who for many years was in the habit of testing the dust from corridors, rooms, and other places at the Brehmer Sanatorium by means of inoculation experiments, only once found any evidence of the presence of tubercle bacilli. We must, however, bear in mind that in a sanatorium patients may not always conform to the regulations and therefore we must be ready to cope with any infected material such as clothing, furniture, and other articles, more especially as our patients have already demonstrated that they supply the necessary soil for the growth of the bacilli. We have given in Appendix No. XVIII., page 37, a summary of a number of experiments on the best means of rendering tubercle bacilli innocuous, whether in sputum, dust, furniture, or clothing, together with a tabulated summary of the various methods adopted in a number of sanatoriums for collecting and disinfecting the sputum and for disinfecting the clothes, crockery, rooms, and furniture.

We will therefore content ourselves with a very brief review of this part of the subject before pointing out the conclusions we have formed. In the first place it has been shown by many observers such as Schill and Fischer, by Steinitz (1901), and Elliott (1902) that with the exception of chlorinated lime it is practically impossible to destroy tubercle bacilli in nummular sputum within a reasonable time by any chemical means or by boiling for a short period of time. Delépine states that a 2 per cent. solution of chlorinated lime is efficacious when mixed with an equal quantity of sputum. Elliott treated nummular sputum with solutions of perchloride of mercury (1 in 500) and carbolic acid (1 in 20) for 24 hours and then injected the central portion of the mass into guinea-pigs. All of these animals died subsequently from tuberculosis. Moeller boiled nummular sputum for 10 minutes and then injected the central portion of the larger masses into animals, all of which developed tuberculosis. These results are due to the fact that the albumin of the nummular masses becomes coagulated by the action of heat or of the chemical substances and so forms an almost impermeable envelope which tends to protect the central portions of the large masses from the disinfecting agent. It is shown in the Appendix on this subject that the only practical methods by which we can destroy the larger masses of sputum are either by means of incineration, boiling in water to which sodium bicarbonate has been added, or the use of chlorinated lime. The addition of sodium bicarbonate to water raises the boiling point to 102° C. and either prevents the coagulation of the albumin or dissolves the albuminate which is formed. In a sanatorium such large masses of sputum should always be collected in some form of flask. It is only the small stray drops which are likely to infect the clothes, furniture, and walls; and as may be seen in our Appendix these small drops may be rendered innocuous in a variety of ways.

The conclusions we have drawn are as follows:—

1. *The sputum.*—The hands, beard, and hair must be kept scrupulously clean and the patients must be instructed always to place a handkerchief in front of their mouths when they cough and never to expectorate anywhere except into some form of flask or other receptacle. Fortunately, most patients rapidly lose their cough under sanatorium treatment, especially if they are told that the act of coughing is detrimental to them, although they continue to get rid of a certain amount of expectoration. Also, in view of the numerous observations on the infectivity of spray from the mouth made by Heymann, Flügge, Boston, Nenninger, and others, to which we have referred, it is imperative that consumptive patients should take the most scrupulous pains with regard to the cleanliness of their mouths. Handkerchiefs must not be used to spit into but only to wipe the mouth; and they should be carried in a special pocket or bag with an indiarubber or oil-silk detachable lining which can be disinfected readily, for, as y Capo has said, a pocket which contains a handkerchief soiled, it may be, with mucus, sweat, or saliva, affords a veritable breeding ground for many forms of micro-organisms. Both handkerchiefs and napkins should be of Japanese paper or some cheap material, such as calico strips, so that they may be burnt. The well-to-do may have ordinary handkerchiefs, provided that they are frequently changed, as paper handkerchiefs are not pleasant things, and napkins, if clean at every meal, as these may readily be disinfected in the steam disinfecting station which we propose to place in the engine block. When in their rooms patients should spit into receptacles made of papier maché. This is sufficiently thick to require no outer covering of metal. The top must be so constructed that flies cannot disseminate the material. Such cups are cheap and are already in use, as is shown in Appendix No. XVIII. (*a*), page 39, at six sanatoriums. The cups should be filled to one-third with a mixture of lysol and soap, as this tends to mitigate the repulsive appearance of the sputum and to prevent drying and dissemination, whilst both Gerlach and Spengler have shown that lysol effectively diminishes the virulence of tubercle bacilli. The paper cups should be removed each day to the electric incinerator which we propose to place in the basement of one sanitary tower in each block and there mixed with sawdust and burnt. By this means the sputum is not constantly being carried through the grounds as at some sanatoriums. When the patients are out of their rooms they should expectorate into a Dettweiler, Guelpa, or other flask, or similar contrivance which can readily be hidden within the folds of a handkerchief and which cannot spill its contents. These flasks should be collected every evening and removed to the incinerating room and there dealt with as follows. The contents should be mixed with sawdust in an iron receptacle and then burnt, whilst the flasks themselves may be treated as they are at the Bichat Hospital. At this hospital they are placed in a copper containing water, to which sufficient washing soda has been added to make it strongly alkaline; the water is gradually raised to the boiling point and kept there for 10 (better 30) minutes. The flasks are then washed out with water and stored for use. Or they may be dealt with as they are at the Hauteville Sanatorium—namely, placed in an autoclave and submitted to a temperature of 120° and a pressure of two atmospheres for half an hour. The vapour flows in and out of the flasks which are thus mechanically washed. They are then thoroughly washed with cold water and dried in hot air.

2. *The walls and floors of the rooms and passages.*—All cleansing of these must be by means of wet cloths, as other means do not remove the dust but simply displace it. It has been said that the sound of a brush or a broom should no more be heard within the walls of a sanatorium than was the hammer within the sacred precincts during the building of Solomon's temple. The floor and the glazed dado should be wiped daily with a damp duster moistened with a solution of 1 in 100 chlorinated lime. The floors may be subsequently polished. The dusters must be periodically burnt. The walls above the dado are extremely unlikely to be infected in a sanatorium where patients are properly educated in dealing with their sputum, as is shown by the researches of many observers, and a periodical thorough scrubbing with

soap-and-water has been shown in many hospitals to be all that is required. When a patient vacates his room it may be well to rub it down with bread, which is afterwards burnt. If, however, there is any reason to suspect that mucus has been expectorated on to the walls it is better—in view of the fact that Coates has shown bread to be useless when there is any sticky mucus on the walls—that these should be moistened and disinfected by formaldehyde, provided that a Trillat's autoclave is used, with other methods formaldehyde is of no service and comes under the same category as all other gaseous methods of disinfection, which, according to a pamphlet of the National Association for the Prevention of Tuberculosis on this subject, are inefficient.

3. *Furniture.*—Furniture should be well wiped with a duster, moistened with a solution of 1 in 100 chlorinated lime, as Delépine states that this agent does not injure furniture if the latter is subsequently wiped with a duster moistened in water; it should be of such a nature that but little dust collects and of such materials that it is readily disinfected. For example, most forms of stuffing or of carpet cannot be satisfactorily dealt with and leather is readily injured in the process, whilst linen covers, washable leather, and wickerwork may readily be disinfected.

4. *Linen.*—Linen, the coverings of cushions, and the like, must be collected in suitable receptacles, the linen being collected every day and taken to one room of a disinfecting station; they should be there thoroughly soaked in cold water in order to remove various stains which treatment with steam tends to fix, and then passed through a steam steriliser and finally dealt with in the laundry.

5. *Ordinary clothes.*—Ordinary clothes, small mats, wicker chairs, mattresses, which should be made so that they can be unpicked readily, and other similar articles may be efficiently disinfected in the same steam sterilising apparatus.

6. *Articles which cannot be sterilised by steam.*—Such articles as books, leather, wool, silks, brushes, combs, and other articles, which are damaged when sterilised by heat may be treated with formic aldehyde generated in a Trillat's autoclave.

7. *Crockery, knives, and forks.*—Crockery, knives, and forks, and the like, can be sterilised in an ordinary surgical steriliser by gradually raising water to which sodium bicarbonate has been added to a temperature of 102° C., and then keeping them at this temperature for at least 20 minutes.

8. *Old articles, dust and refuse.*—Infected rags, paper, old mattresses, pillows, dusters, &c., which are no longer required, together with the various forms of dust and refuse, and their receptacles, should be dealt with in a dust destructor attached to the engine-house.

9. *Bedroom and other slops* probably do not require to be disinfected, at most the various utensils may be periodically scalded.

FIG. 7.

Service block, ground floor plan. (Scale—one-thirty-second of an inch to the foot.)

Necessary accommodation for disinfection purposes.

We see, then, that so far as the structure of a sanatorium is concerned we must have:—

1. A disinfecting station. This we have placed in the block which provides accommodation for the engines and the laundry.
2. A room in the basement of a sanitary tower in each block, where the sputum and handkerchiefs may be burnt and flasks and other articles sterilised.
3. A place where various other articles such as refuse and the contents of dustbins may be dealt with in a dust destructor. This we have provided in the engine block.

FACILITIES FOR OBSERVATIONS AND RESEARCH.

Observation.—A laboratory (see Fig. 9, p. 24) together with a record room, is provided in the immediate vicinity

of the quarters for the medical men for the routine examinations of various materials, such as sputum and urine, whilst separate rooms, with waiting hall attached, are placed on the ground-floor of the eastern wing of the administration block (see Fig. 8, p. 23) for the x ray, dental, and throat departments, which experience has shown are necessary in a large sanatorium. It has been found that the routine examination of patients by the physician is most satisfactorily carried out in the individual bedrooms, but these special rooms may be used for consultation purposes when the occasion arises. The number of these rooms, as may be seen from the figure, may readily be increased if any new form of treatment or observation is devised in the future. The sick block is provided with an operating theatre and its necessary adjuncts (see Fig. 12, p. 25).

Research.—The sanatorium is to be equipped with all requirements for scientific research, and we have come to the conclusion that any experimental work is best done as far away as possible from the patients' buildings and have accordingly grouped the necessary rooms in the laundry and disinfecting block, but in such a position (see Fig. 7, p. 22) that they are free from any liability to the vibration which may be caused by the engines. The rooms will consist of a laboratory for bacteriological and pathological research which is in communication with the post-mortem room and a laboratory where chemical, physical, and physiological problems may be worked out. In the immediate vicinity of these laboratories are three small research rooms, together with a director's room, which will also serve as a record room and library. Attached to the same block is a well-ventilated animal house, without which many of the scientific questions which will arise cannot be elucidated. Meteorological requirements are met by the provision of various instruments mentioned in Appendix No. XX., p. 42.

THE LAUNDRY ARRANGEMENTS.

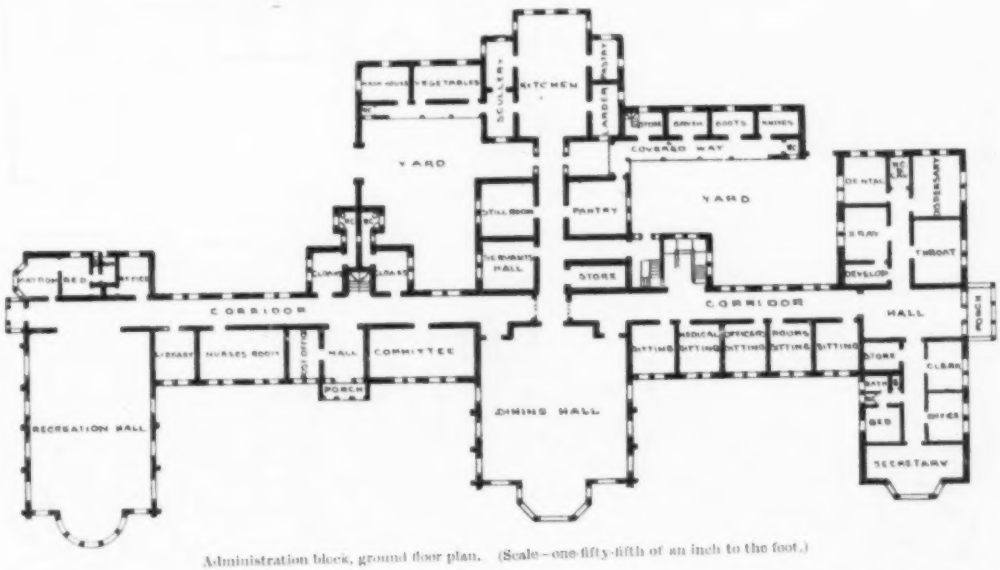
Ample accommodation (see Fig. 7, p. 22) is provided for laundry purposes in the same block as the engine-house, the disinfecting station, and the research laboratories. The washing room is in direct connexion on the one side with the room in which various articles, such as linen, are placed *after* disinfection, and on the other with a drying chamber of the most modern type. The drying chamber communicates directly with the finishing room and this in turn with the outside. All laundry work will be done by electricity, as may be seen from Appendix No. XVII. (*b*), p. 36.

SHORT DESCRIPTION OF THE VARIOUS BUILDINGS.

The details of the various buildings which have not yet been described will be most readily grasped by a reference to the individual plans in which the character of the various rooms is specified; we will, however, briefly refer to the leading features of each.

1. *Administration block* (Figs. 8 and 9).—The administration block has a southerly aspect and consists of a central portion and two wings, whilst a corridor which leads on to the open at either end runs from east to west through the entire length of the building. On the southern side of the central portion, on the ground floor, is a dining-room (52 × 50 feet with a bay window 22 × 12 feet) for the majority of the patients which can be reached from the entrance hall by means of a door revolving on a central pivot to prevent draughts and to keep the entrance hall free from the smell of cooking. This room will be supplied with heated carving tables so that the food may be kept sufficiently hot. Immediately behind the dining-room, but separated from it by the corridor, is the necessary kitchen and pantry accommodation. Doors will be arranged in this corridor of such a kind that when meals are being served they can completely shut off a portion of the corridor from

FIG. 8.



Administration block, ground floor plan. (Scale—one fifty-fifth of an inch to the foot.)

all parts of the house whilst allowing the passage of servants from the kitchen to the dining-room; at other times the doors will be against the wall and will allow the free circulation of air from end to end of the corridor. The kitchen is completely cut off from the rest of the building by aerial ventilation, whilst ample provision is made in the way of pantry, bakery, scullery, cold storage, and other accommodation.

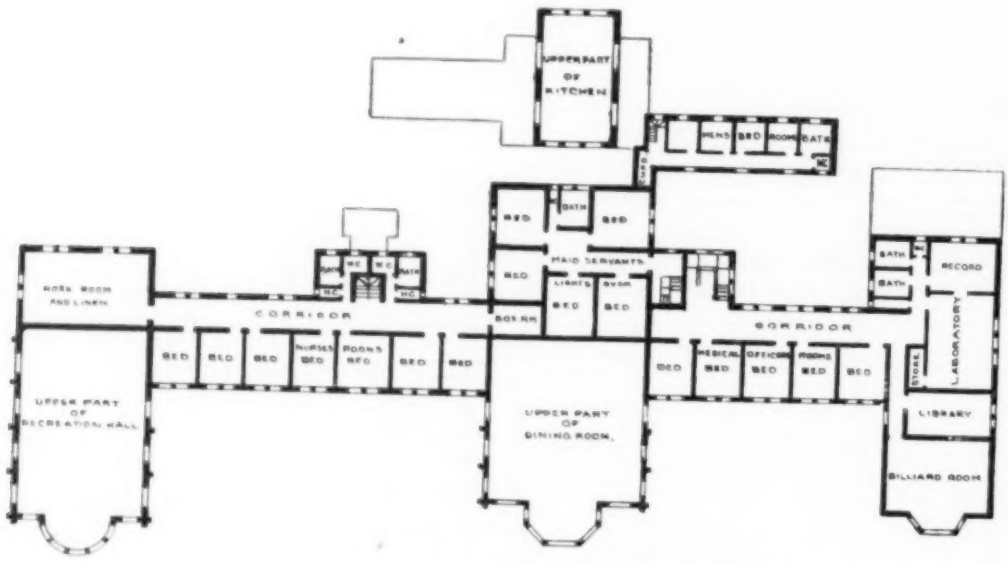
The western wing of the maintenance block consists of an entrance hall with post and telegraph office, a committee-room, nurses' sitting-room, recreation-room which may also contain the library of the establishment, and matron's quarters, together with male and female lavatory accommodation for the patients which is well cut off from the rest of the building and conveniently placed near the entrance hall and dining-room.

We have only arranged for one recreation-room, as we have already pointed out that patients must not be tempted to stay indoors. The Appendix on this subject (No. XV., page 34) shows that in many sanatoriums no common room beyond the dining-room is provided for the patients. At such sanatoriums the patients are allowed to sit in the dining-rooms after meals for half an hour or more, and occasional entertainments are given there. The recreation-room we

have provided will do away with the necessity of patients ever having to breathe the contaminated air which this practice entails.

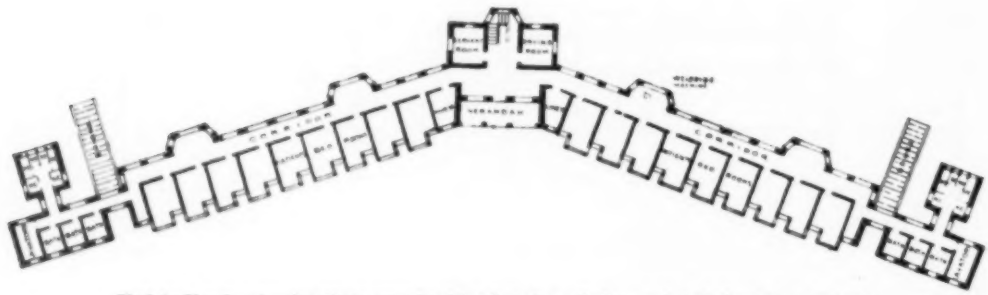
The eastern wing contains the sitting-rooms of the medical staff, the secretary's quarters, the dispensary, and the rooms for special forms of treatment, such as the use of the x rays. On the first floor there is accommodation for servants over the northern part of the central portion, whilst the nurses

FIG. 9.



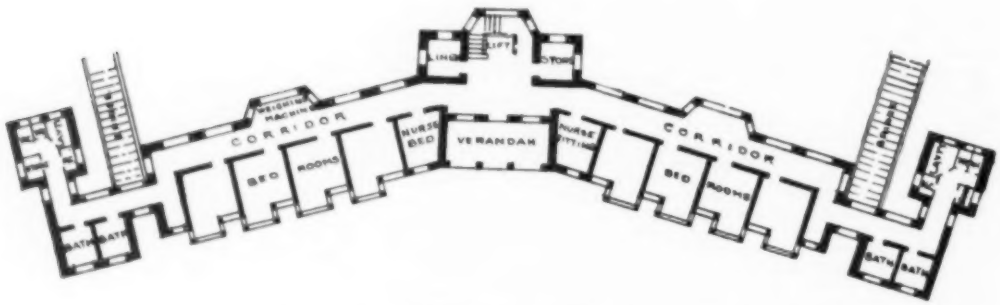
Administration block, first floor plan. (Scale—one-fifty-third of an inch to the foot.)

FIG. 10.



Block for 36 male or female patients, ground and first floor plan. (Scale—one-sixtieth of an inch to the foot.)

FIG. 11.



Block for 16 patients in bed, ground and first floor plan. (Scale—one forty-second of an inch to the foot.)

are provided for in the western wing. The bedrooms of the medical staff, together with a billiard-room, routine laboratory, record-room, and the necessary bathroom and other accommodation occupy the eastern wing. The stairs are so arranged that the various portions of the first floor are independent of one another. There will be a small private road leading to this block.

2. *The block for 36 male patients* (Fig. 10, page 24).—This is two storeys high and one room deep. On each floor are 18 rooms for patients, the aspect of which varies from S.S.E. to S.S.W., as the building consists of two wings joined by means of an open-air gallery (30 feet by 10) at an angle of 145°. An open-air gallery is not essential in the case of the larger blocks, but it adds to their efficiency, as any of the convalescent patients who suffer, as they not infrequently do, a slight relapse, may rest here. It will be entirely open but provided with rain and sun screens on its southerly aspect, whilst its northern aspect will consist largely of window-space, so that a proper through-draught of air may be readily obtained.

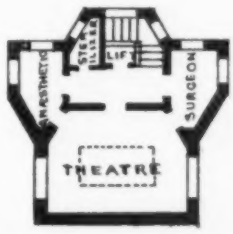
The rooms on the ground floor, as we have seen, are raised sufficiently above the ground to ensure privacy. Behind the patients' rooms runs a corridor six feet broad which is amply provided with windows, one of which, as we have already stated, is placed opposite the doors of all the patients' rooms. At either end of the corridor is a window or door, which leads directly on to the open. The upper floor is connected at either end by means of an iron bridge with a path on the

that any portion of the building may readily be isolated in case of need.

3. *The block for 36 female patients*, Fig. 10, page 24.—This is in every respect identical with the last except in so far as sleeping accommodation is found for two female servants.

4. *The block for 16 patients* who for various reasons have

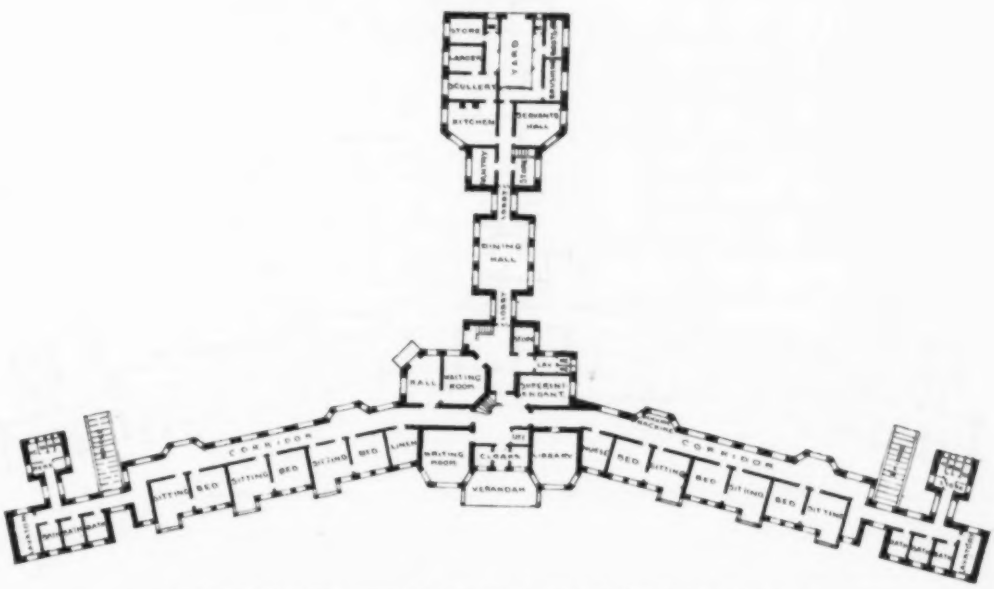
FIG. 12.



Block for patients in bed, top floor plan.
(Scale—one-thirty-second of an inch to the foot.)

to remain in their rooms, Figs. 11 and 12.—This is also almost identical with the larger blocks save that the dimen-

FIG. 13.



Block for paying patients, ground floor plan. (Scale—one-forty-eighth of an inch to the foot.)

sloping elevation immediately behind the house. Bay windows (16 feet by 6 feet) project from the northern side of the corridors, so that patients who are confined to their rooms may utilise them in hot weather or in southerly gales. Accommodation is also provided in the corridor for the weighing of patients. In addition on either floor and at either end of the wings are the sanitary towers to which we have already referred in detail. Provision is made for cloak- or drying-rooms where boots may be removed on both floors as the bridge on the second floor allows patients to come on to the second floor directly from outside. There is an ample supply of store and linen rooms. Electric heaters will be placed on each floor. There is sleeping accommodation for two male servants and day accommodation for any nurse who may be required. Sufficient space is left in the immediate vicinity of the staircase for a lift, which, however, we do not consider will be necessary. The corridors are so arranged

sions of the open-air gallery are somewhat larger, there is sleeping and day accommodation for two nurses, and a small operating theatre (Fig. 12) with its necessary adjuncts is provided. A block of this kind will require an electric lift.

5. *The block for 12 more wealthy patients*, Figs. 13 and 14.—This block is also on the same lines. Each patient, however, will have a sitting-room as well as a bedroom merely in order that when resting on his sofa chair he may have somewhat more comfortable surroundings. The men and women should have rooms on separate floors. A library and a recreation room are added. There is separate dining and kitchen accommodation which is placed at the back, well cut off from the rest of the building, whilst rooms are found for the necessary servants. The accommodation is superior to that of other blocks and a lift is provided.

6. *Accommodation for visitors.*—With the exception of two spare bedrooms in the block for patients with more

ample means no rooms are provided for visitors, because we are of the opinion that any visitors who may be permitted to come to the sanatorium from time to time are best housed in neighbouring cottages.

7. *Provision for religious services.*—No church or chapel will be provided as we hold that anything which tends to make tuberculous individuals congregate under cover is to be avoided. Services, moreover, may readily be held in the open air.

8. *Block for engine-house, laundry, disinfecting station, and research laboratories, together with a mortuary and post-mortem room.*—This block will be placed at a considerable distance from the patient's rooms and conveniently near a road. The accommodation (see Fig. 7, page 22) for research and laundry purposes has already been sufficiently described. The disinfecting station, see Appendix No. XVIII., page 37, consists of two rooms, completely separated from each other by a brick wall, into which the steriliser is built so that it communicates with both rooms, one door of the disinfector opening into one room and its fellow into the other. The infected articles will be brought into one room and removed when disinfected from the other side of the disinfector and dealt with as may be necessary. No communication save by telephone exists between the two rooms, the walls and floors of which are of cement. The mortuary is so placed that it may readily be reached by a hearse without notice being attracted and the post-mortem room is in connexion with the laboratories. A dust destructor and an ice-house are also provided in this building.

The engine-house, with accommodation for an engineer and his wife, will form part of this block, but will be so placed that no vibration will be communicated to the laboratories.

AN ALTERNATIVE PLAN.

This is added (see Figs. 15, 16, and 17, separate plans) in case either the character of the site or the amount of money at disposal prevents the adoption of the separate block system. It consists of a central portion and two long wings. The general arrangement is the same in the separated block scheme. The central portion consists of a recreation-room and the quarters for the medical staff, together with dining-room and kitchen accommodation in a northern annexe. The eastern wing consists of two floors and contains rooms for 44 female patients, together with open-air galleries, sanitary towers, and nursing and other rooms. The western wing in a similar way provides for 44 male patients. An operating theatre is placed on the second floor of the central portion. The patients with more ample means will have a separate house, as in the other scheme, whilst no change is made with regard to the engine and laundry block.

MEANS OF COMMUNICATION.

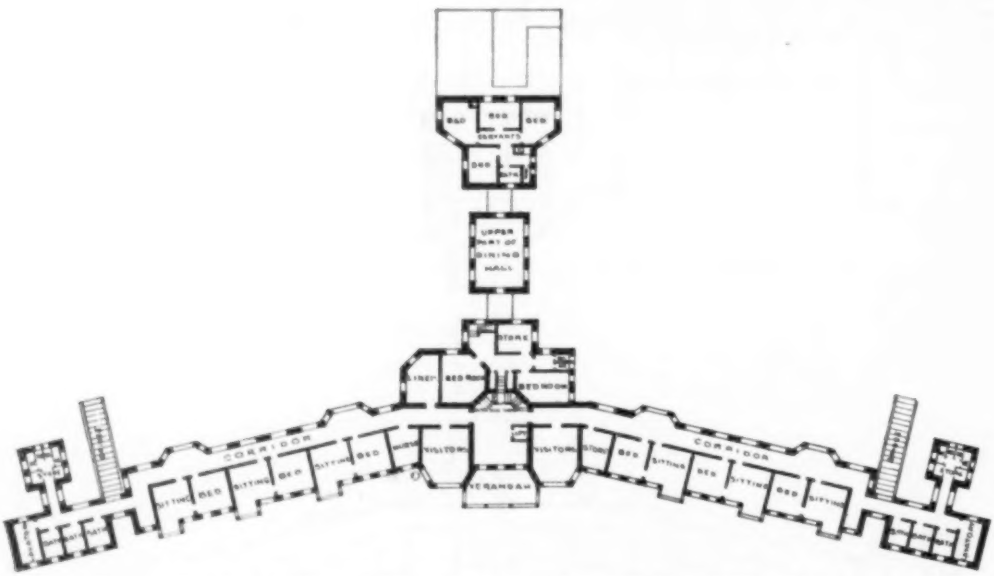
The separate blocks and the power house should be amply supplied with telephonic communication to the administration block and to the doctor's quarters. Each patient's room should be provided with an electric bell which rings into the corridor during the day and into the nurses' bedroom at night, or if there is no nurse in the block in to the servants' room so that a nurse may be summoned if necessary.

THE LAYING-OUT OF THE GROUNDS AND THE PROVISION OF SHELTERS.

This naturally must depend entirely upon the character of the available land. No better guide exists than the magnificent grounds attached to Brehmer's original sanatorium at Görbersdorf. Walks of varying gradients must be provided; some on the level ground in the immediate neighbourhood of the buildings for patients who are restricted to this form of exercise; others of gradients varying from 1 in 300 to 1 in 60 for the more convalescent cases. These paths must be carefully prepared so that they readily absorb moisture and rapidly dry after rain. This is best done by laying them down with rubble or ash (not cinder) under a covering of gravel. The walks must be varied, so that shelter may be obtained whatever the direction of the wind. Some paths must be laid through the woods, which give shelter from rain sun, and wind; others must be in the open. Care must be taken, as far as possible, to prevent any path overlooking the patients' bedrooms, whilst no path for the use of the patients should lead downwards away from the buildings towards the valley, as it is important that patients in returning from their walk should do so downhill and so avoid any over-exertion. In the case of certain sanatoriums the gradients of the various paths are marked on the trees by coloured bands, but there is no occasion for this as the character of each patient's walk should be entirely under the direction of the physician.

In the grounds of Brehmer's sanatorium seats are provided every 20 paces so as to allow any patient to stop and to rest the moment he feels that there is any necessity to do so. Whilst

FIG. 14.



Block for paying patients, first floor plan. (Scale—one forty-eighth of an inch to the foot.)

it is true that many seats must be provided and that these should be so arranged that advantage is taken of the view, a seat at every 20 paces seems unnecessary. At Nordrach the difficulty is overcome by each patient carrying a small square of thick rubber, as in this way the patients can select their own resting-place and avoid sitting in the immediate proximity of their fellow patients. Individual seats may be named so that patients may know the particular walk they have to take. Trees, preferably evergreens, should be arranged near the house so as to give shelter against wind for the more feeble patients, whilst at the same time they allow the free ingress of air and sunlight.

Shelters of various descriptions, in addition to the covered way already described, must be placed in the grounds, not only near the house for the use of feeble individuals, but at more distant points. They are necessary for protection against wind, excessive sun, and rain; they should be as simple in construction as possible, readily disinfected and cleaned like all other furniture in the establishment, and so placed as to allow a free circulation of air and to take advantage of the natural beauties of the country. It is best that many of them should turn on a pivot, as shelter from any wind is so obtainable; in cases where the natural configuration of the grounds affords sufficient shelter fixed huts may be used. It is an advantage that some of the shelters should be fitted with electric light. Leriche advocates the establishment of a *cordon sanitaire* round the grounds, but there is no reason why convalescent patients should be confined to the private grounds of the sanatorium unless these are very large, provided that they do not go near places where there is much dust or human traffic. In addition, provision must be made for the necessary supply of vegetables, with some flowers and plants for the larger rooms, and the grounds should be laid out in as attractive a manner as the money at disposal allows.

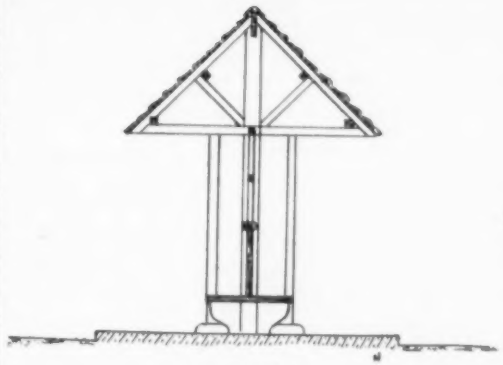
A Covered Way between the various Buildings.

When a sanatorium is built on the separate block system it is as well, at any rate in England, to have a covered way from house to house, so that the patients may avoid unnecessary exposure on their way to and from the dining-room. As may be seen from Fig. 1, page 14, we have provided a covered passage between the buildings, which we have arranged in the form of a crescent. The block for the female patients is joined on the one side with the administration block and on the other with the sick-house, whilst the block for male patients is joined with the administration block and with the house set apart for the more wealthy patients. In this manner the medical staff may visit all the houses without being exposed to inclement weather, whilst the fact that the more wealthy patients and the more severe cases respectively are placed at either end of the crescent will prevent any great traffic through the corridors of the houses for 36 male and female patients. The covered passage (Fig. 18) will be freely open in the immediate neighbourhood of the individual houses, so that it cannot ventilate into them. Elsewhere it will be provided with glazed screens at intervals which will give shelter to those sitting on the seats provided on the outer aspect of each side. The arrangement of these seats should be of great service, as by means of them patients who are unable to go into the woods will readily obtain protection from any wind.

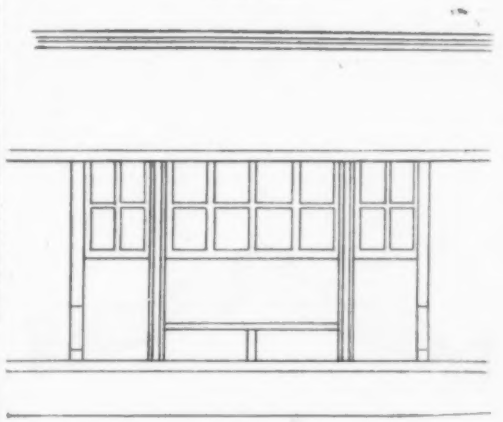
The Cost of the Proposed Scheme.

It is impossible to give any definite statement as to the cost of the proposed scheme without knowing the cost of labour and of materials at the chosen site and other details. Many sanatoriums have been built for the poor at a cost of from £250 to £300 a bed, but modern sanatoriums, which contain single-bedded rooms and are constructed with a view to comfort, are more expensive. Thus, the Hohenhonnef, which consists of one large block and accommodates 109 patients, cost £660 a bed; the Anstalt, at Nordrach Colonie, for 24 patients, which is usually held up as an example of cheapness, cost £500 per bed; the projected sanatorium at Manchester (100 patients) is expected to cost £1000 per bed; and the projected Brompton Sanatorium at Frimley for 100 beds in one large block is to cost £56,000, whilst the most recent fever hospitals in England, hospitals which have as many as 20 patients in a ward, cost from £500 to £550 a patient.

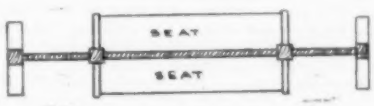
FIG. 18.



a. In section.



b. In elevation.



c. In plan.

Covered way—*a*, in section; *b*, in elevation; and *c*, in plan. (Scale—one-sixth of an inch to the foot.)

APPENDIX I.

Consisting of a Summary of the Main Features of the Scheme.

It has been decided from various considerations detailed in the text to build the sanatorium on the separate block system (see Fig. 1, page 14). The building will be arranged, if the site permits, in the form of a crescent and will comprise:—

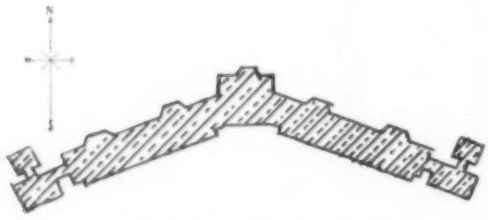
1. Administration block with dining and other accommodation.
2. Block for 36 more or less convalescent male patients.
3. Block for 36 more or less convalescent female patients.
4. Block for 16 patients who for various reasons are confined to their own rooms for the greater part of the day.
5. Block for 12 patients with more ample means.
6. Block for engine-house, laundry, disinfecting station and research laboratories, together with a mortuary, post-mortem room, and other accommodation.

GENERAL DETAILS OF CONSTRUCTION.

The outside of the buildings will be made as attractive as possible. In the patients' blocks the rooms are placed on one side of a corridor which has windows on the opposite side. All buildings for the patients, together with the administration block, are two storeys high. Precautions are taken against the conduction of noise and the possibility of fire. Adequate measures are taken to make the buildings dry and to insure the privacy of the rooms. The buildings will be of concrete and steel girders, the partitions being made of cement. All angles will be rounded off and no mouldings or projecting architraves will be used. The floors of the rooms will be of teak, the walls being lined in such a way that they can be readily cleaned. The ceilings will be lined with mezzotile. The stairs will be of teak. All windows will be casements with fanlights carried flush to the ceiling and specially fitted so as not to afford any lodgment for dust. All glass will be plate. All buildings are so arranged that any portion may be readily isolated in case of need. (See Block plan, Fig. 1, page 14.)

1. *The administration block* (Figs. 8 and 9, pages 23 and 24).—This is placed on a *slightly* higher level than the other buildings and will have a small private road leading to it. The main aspect is southerly. In this block are placed the kitchen and dining accommodation for the greater number of patients, male and female lavatory accommodation, post and telegraph office, quarters for the medical staff with laboratory for routine examination, and rooms for special departments such as x-ray, dental, and throat rooms, nurses' and servants' quarters, accommodation for secretary and matron. Special arrangements are made so that the

FIG. 19.



Sketch of block for 36 convalescent patients.

kitchen and dining-room may not ventilate into other portions of this block, whilst the part used by the patients is entirely cut off from the rest of the building. For reasons given in the text only one recreation room is provided. This room can also serve the purpose of a library.

2. *Block for 36 more or less convalescent male patients* (Fig. 10, p. 24).—This is two storeys high and contains 18 rooms on each floor for patients. The aspect of these rooms varies from S.S.E to S.S.W., the building consisting of two wings (see Fig. 19) placed at an angle of 145°. The rooms on the ground floor are raised sufficiently above the ground to insure privacy. Behind the patients' rooms runs a corridor six feet broad which is amply provided with windows, one of which is placed opposite the door of each of the patients' rooms and is covered with cork carpet to lessen the noise of the necessary traffic. At either end of the corridor is a window or a door which leads directly on to the open and so permits of the free circulation of air. The upper floor is connected at either end by means of a bridge with a path on the sloping elevation immediately behind the house. In the corridors bay windows (16 feet by 6 feet) project so that patients who are confined to their rooms may utilise them in hot weather or in southerly gales. In addition, on either floor and at either end of the wings are sanitary towers which are completely cut off from the patients' rooms by aerial cross-ventilation, and which contain lavatory, baths, water-closet, and housemaid's sink accommodation. Provision is also made for cloak-rooms, linen- and store-rooms, day nurses' accommodation, and for two male servants' sleeping accommodation. On either floor in the centre of the building is a small open-air gallery with a southerly aspect for the use of any of the patients housed here who may suffer a relapse. The open-air galleries are not essential in the case of the larger blocks, but in our opinion add to their efficiency, whilst the exact position of the sanitary towers in these blocks must be determined by certain considerations mentioned in the text.

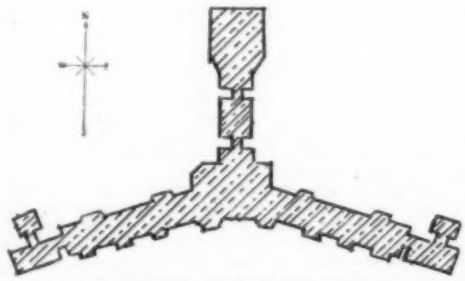
3. *The block for the 36 women* (see Fig. 10, p. 24) is in nearly every respect identical with the last save that quarters are found for two female servants instead of the male servants.

4. *The block for 16 patients who are more or less confined to their rooms* (see Figs. 11 and 12, pages 24 and 25) is also almost identical with the larger blocks save that the open-air gallery is somewhat larger, whilst there are day and night accommodation for two nurses and a small operating-theatre with its necessary adjuncts. This block will have a lift.

5. *The block for 12 well-to-do patients* (see Figs. 13 and 14, pages 25 and 26) is on the same lines. Each patient will, however, have a sitting-room as well as a bedroom. These sitting-rooms will only be used when the patient is resting on a sofa-chair. Two recreation rooms for occasional use are added on the same lines as those in the administration block. The accommodation is superior to that of the other blocks and a lift is provided. Separate kitchen and dining accommodation is found for these patients, but this is well cut off from the bedrooms and is placed behind the building, as may be seen from the accompanying sketch (Fig. 20). A superintendent and a separate staff of servants will be attached to this block.

6. *Block for engine-house, laundry, disinfecting station, and research laboratories, together with a post-mortem room, mortuary, and other accommodation* (see Fig. 7, page 22). The laundry and disinfecting station are of the most modern

FIG. 20.



Sketch of block for 12 well-to-do patients.

type and communicate with one another. Ample provision is made for the elucidation of bacteriological, pathological, chemical, and other problems in connexion with tuberculosis. A post-mortem room immediately adjoins the laboratories, and a mortuary is conveniently placed near the road. The engine-house is placed in the same block but in such a position that no vibration will be communicated to the laboratories. It will contain the necessary electrical plant, together with accommodation for an engineer and his wife.

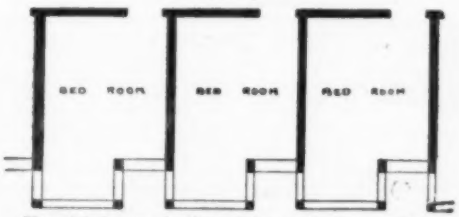
Each room for an individual patient (see Figs. 2 and 3, pages 16 and 17) is 10 feet high, 12 feet broad, and 14 feet deep. The way in which the walls are to be lined depends upon the amount of money available, but we propose that they should be lined with artistic glazed tiling to the height of three feet six inches and then oil-painted. In the case of the rooms for the more wealthy patients washable paper will be employed. The floor will be of teak. Precautions are taken to prevent the head of the bed coming within one foot of the wall. The door is to be sufficiently wide (3 feet 6 inches) to allow a bed to be wheeled through, and is placed opposite a window in the corridor. Above the door, and throughout the upper part of the northern wall, are fanlights 2 feet deep. The south side consists chiefly of window space; there is a square projection at the eastern (or the western as the case may be) half of this aspect of the room, 7 feet wide, 4 feet deep, and 10 feet high. This projection is so arranged, as may be seen from Fig. 21, that it has a window looking south and smaller ones looking east and west. We object, for reasons given in the text, to the use of verandahs or galleries where many patients can assemble and our aim is to afford each patient, by means of these projections, a place in which to rest upon his sofa-chair under such conditions, that whatever the

state of the weather he may always be able to open one or more windows and so enjoy the necessary free circulation of air. We regard these projections as most useful, but we have arranged the buildings in such a way that they can be dispensed with, without affecting the general scheme, if there is not sufficient money available for their erection. On the western (or eastern as the case may be) half of the south aspect is a window three feet six inches wide. Above these casement windows in all cases are fanlights, the top of which is flush with the ceiling. The casement windows commence two feet six inches from the floor. Each room will have a special piece of furniture open at the back so that it may be thoroughly cleaned, and comprising wardrobe with sloping roof, drawers, looking-glass and washhandstand, in addition to the ordinary furniture. Light perforated blinds are provided for protection against sun and rain.

With the exception of two spare bedrooms in the block for patients with more ample means no rooms are provided for *visitors*, because we are of opinion that any visitors who may be permitted to come to the sanatorium from time to time are best housed in neighbouring cottages. No *church or chapel* will be provided, as we hold that anything which tends to make tuberculous individuals congregate under cover is to be avoided. Services, moreover, may readily be held in the open air. The *lighting* will be by means of electricity. The *ventilation* will be almost entirely by means of open windows. In addition each patient's room is provided with an electric fan for use in still and hot weather, together with a small shaft with mica flap to prevent down draught. The larger rooms, such as the dining-rooms, and other parts of the building, such as the kitchen, water-closets, and the like, are amply provided with electric extractor fans.

All heating and cooking is carried out by means of elec-

FIG. 21.



Plan of bedrooms showing window projections. (Scale—one-sixteenth of an inch to the foot.)

tricity with the exception of the heating required for warming water for baths, for laundry purposes, or for the steam disinfector. Heating for these latter will be provided, for economical reasons, by means of upright boilers worked by coke and supplied with efficient smoke destructors. The electricity will be generated by means of water power, gas, or oil, according to the possibilities of the site; in this way the use of coal and coke, which we show in the text is most injurious, is, as far as possible, avoided (see Appendix No. XVII. (*b*), p. 36, for specification).

The *drainage* will be directed, if possible, into ordinary sewers (see Appendix No. XIX., p. 40, for specification), but, failing this, into a large impervious tank, the contents of which will be dealt with on the biological system of Cameron. The *slop-water* will be disposed of by means of Kenwood's system of sub-irrigation.

The methods adopted to prevent the *spread of infection* and for the destruction of tubercle bacilli will be as follows:—

(*a*) The sputum will be collected in pocket flasks and in the patients' rooms by suitable papier-maché cups. These cups and their contents, together with the contents of the flasks, will be mixed with sawdust and burnt in special small incinerators in each block. The flasks will be thoroughly disinfected in the same rooms, being placed in water to which sodium bicarbonate has been added and then gradually raised to 102° C. and kept at this temperature for half an hour. Handkerchiefs will be of some cheap material and burnt after use, but the well-to-do patients may have ordinary handkerchiefs which will be disinfected in the steam disinfecting station.

(*b*) The floors, the tiled portion of the walls, and the furniture will be kept clean by means of moist cloths dipped in a 1 per cent. solution of chlorinated lime. The walls will periodically be well scrubbed with soap-and-water and, when the patient leaves, disinfected by formaldehyde vapour generated by a Trillat's autoclave.

(*c*) Linen, coverings to cushions, ordinary clothes, small mats, wicker chairs, mattresses, and the like will be collected in suitable receptacles and treated in the steam disinfecting station.

(*d*) Articles which cannot be sterilised by steam, such as books, combs, and the like will be disinfected by formaldehyde, generated by a Trillat's autoclave in a special chamber.

(*e*) Crockery and knives and forks will be treated in ordinary surgical sterilisers.

(*f*) Old articles, dust, and refuse will be dealt with in a special dust destructor attached to the engine-house.

FACILITIES FOR OBSERVATION AND RESEARCH.

1. *Observation.*—X-ray, dental, and throat-rooms with test laboratory and record-room are provided in the administration building.

2. *Research.*—Two laboratories for bacteriological, pathological, chemical, and physiological work, research-rooms, an animal house, and a post-mortem room, &c., are placed in the laundry block. Facilities for meteorological observations are also provided.

THE GROUNDS.

These will be carefully laid out with paths on the flat and of varying gradients. The paths will be of such a nature that they dry readily after rain. *Shelters*, some of them on pivots, are provided. The grounds, and some of the shelters, will be efficiently lighted with electricity. The various buildings are connected with the maintenance block by a *covered passage* (see Figs. 1 and 18, pages 14 and 27). This in the immediate vicinity of the buildings is open, but elsewhere a central glazed screen placed at intervals will give shelter from the wind. On the outer portion of this covered way on either side are seats at short intervals, which are protected by the overhanging roof. By this means patients who are unable to go into the woods will readily obtain protection from any wind. The various blocks are so placed with regard to this passage that there is a minimum of traffic through the corridors. There is ample *telephonic communication* between the various buildings and the doctors' and other quarters, together with a complete installation of electric bells.

AN ALTERNATIVE PLAN

for 88 patients, embodying similar ideas and principles (see Figs. 15, 16, and 17, separate plans), but consisting of one large single building, is appended, in view of the facts that it is impossible to come to any definite decision as to the character of the building without complete knowledge of the configuration of the proposed site and of the amount of money which is at disposal.

APPENDIX II.

SHOWING THE STATISTICAL RESULTS OF TREATMENT IN 44 OPEN-AIR SANATORIUMS.

(*a*) In 23 established for the well-to-do.
(*b*) In 16 established for the poor.
(*c*) In 5 established for children.

The statistical results of the open-air treatment of tuberculosis are useful, but are open to the objection that at present they are not all calculated in the same manner. Thus the medical men at some sanatoriums regard a case as being permanently arrested on slighter evidence than others; some, again, take the absence of physical signs or of bacilli in the sputum as a test, whilst others are only content with more or less complete restoration of the working capacity. It will be seen that the following statistics are not always strictly comparable; they, however, show the general limitations of this form of treatment.

(a) 23 Sanatoriums for Paying Patients.

Name of sanatorium.	Stage A = comparatively early; B = advanced.	Percentage of cases in which there was apparent arrest of the disease.	Total percentage of cases in which there was real improvement.	Authority.
Brehmer	A and B	26·6	75 to 80	M. Achtermann.
	A	58·0	89	Kobert.
Nordrach Colonie	A and B	30	96	Knopf.
Hygeia	A and B	22·5	68·7	A. C. Klebs.
Falkenstein	A	28	73	Dettweiler and Hess.
Reiboldsgrün ...	A	41·6	70·2	Driver.
Canigou	A	55	65	Giresse.
	B	6	31	
Hohenhonnef ...	A	43·4	69	Meissen.
Leysin	A and B	12·7	72·2	Burnier.
	A	53·3	86·6	
Winyah	A	81	100	von Ruck.
	A and B	22·6	65	
Davos (Turban) ...	A	50	90	Turban.
Muskoka Cottage	A	41	74	Elliott.
Römpler's	A and B	27	77	Rompler.
Sharon	A and B	25	—	Bowditch.
Haufe's St. Blasien	A and B	17	84	Sander.
Montana	A	10	50	Stephani.
	B	2	12	
De Trespoey ...	A and B	22	55	Crouzet.
Laurentian	A	46	62	Riched.
	B	18	40	
Sanatoriums in England.				
Nordrach on Mendip	A	45	82	Rowland Thurnam.
Moorcote	A	85	100	Baker.
	B	10	60	
Crookesbury	A	45	87	R. Walters
	B	0	45	
Rudgwick	A and B	31·5	89·5	McCall
Nordrach in Wales...	A and B	77·2	84·2	Morton-Wilson.
Rossclare	A	20	95	Crosby Walch

(b) 16 Sanatoriums for the Poor.

Name of sanatorium.	Price per week.	A = comparatively early. B = advanced.	Percentage of cases in which there was apparent arrest of the disease.	Total percentage of cases in which there was real improvement.	Authority.
Grabowsee	£1 or less.	A and B	14·1	78·5	Ellerhorst.
Halila	£1 or over.	,,	27·0	70·7	Gabrilowitch.
Davos (Basel) ...	About £1.	A	67·7	90·8	Kuñdig.
Adirondack	£1.	,,	57·11	77·1	Trudeau.
Loslau	£1.	A and B	11·0	89·0	Schrader.
Oderberg and Glückauf	*Nil.*	,,	4·0	77·0	Ott.
Montefiore Home	*Nil.*	,,	10·6	41·4	Herbert.
Braunwald	18s.	A	39·0	99·6	Fischer.
		B	11·0	90·0	
Reknaes	10s.	A	39·0	91·0	Kaurin.
		B	1·8	68·8	
Sanatoria of Scotland	—	A	19·0	90·0	Hyslop Thomson.
Belzig	*Nil.*	A and B	17·2	82·8	Moeller.
Hauteville	15s.	—	45·0	88·0	Dumarest.
Loomis	£2.	A	25·0	75·0	Stubbert.
Chestnut-hill ...	—	—	8·0	19·5	Cohen and Bacon.
Ventnor	10s.	A	16·4	81·8	Coghill.
Ruppertshain ...	18s. or over.	,,	30·0	70·0	Nahn.

(c) Five Sanatoriums for Children.

Name of sanatorium.	Stage A = comparatively early; B = advanced.	Percentage of cases in which there was *apparent arrest of the disease.*	Total percentage of cases in which there was *real improvement.*	Authority.
Ormesson	A	34·0	64·0	Jaoul.
Villiers	A	25·5	69·9	Vagnier.
Forges les Bains	A	50·0	75·0	Dumenge.
Arcachon	A	21·7	67·6	Lalesque.
Refsnaes	A	25·0	67·4	Shepelern.

In addition to the above many sanatoriums, such as Malchow, Schömberg, Grabowsee, Rehburg, &c., give statistics under the headings of "greatly improved" and "improved." The percentage under either heading is about 40 to 50 in the early stages. Solly states that, taking all non-Alpine sanatoriums together, the percentage of improvement in early stages is 95, in later stages 58, whereas in the case of patients who are not treated in sanatoriums the percentages respectively are 71 and 28 in lowland climates and 89 and 63 in highland climates.

APPENDIX III.

SHOWING WHETHER BETTER RESULTS ARE OBTAINED AT ANY PARTICULAR SEASON OF THE YEAR AT 48 SANATORIUMS.

—	No. of sanatoriums.	Names of sanatoriums.
I.—Definite statement that no different results are obtained at any particular season.	21	Moorcote, Nordrach Colonie, Cotswold, Montefiore Home, Hohenhonnef, Ruppertshain, San. des Pins, Hauteville, Oderberg, Falkenstein, Braunwald, Reknaes, Rossclare, Nordrach-on-Mendip, Linford, Canigou, Beauregard Montana, Glückauf, Rostrevor, Brehmer.
II.—No noticeable difference observed.	11	Luitpoldheim, Boscrup, Chico Springs, Reiboldsgrün, Waldhof-Elgershausen, Friedrichsheim, Consumption Sanatorium of Scotland, Belzig, Vale of Clwyd, Davos German, Davos Dorf.
III.—Best results in winter.	16	Loomis, Durham, Rudgwick, Sülzhayn, Zarskoje, Halila, Dunstone Park, Grampian, Crooksbury, Holne Chase, Nordrach-on-Dee, Nordrach-in-Wales, Adirondack, East Anglian (October, November, December), National Hospital for Consumption in Ireland, Loslau, Laurentian, Montefiore Home.

APPENDIX IV.

SHOWING THE CLASS OF CASES REFUSED BY 46 SANATORIUMS.

(a) 17 Sanatoriums which refuse only those patients who are in a moribund condition.—Nordrach Colonie (discourages diabetes), Rudgwick, Cotswold, Montefiore Home, Friedrichsheim, Hohenhonnef, Rossclare, Zarskoje, Selo, Dunstone Park, Grampian, Holne Chase, Vale of Clwyd, Nordrach-in-Wales, Linford, Guimar, Rostrevor.

(b) 24 Sanatoriums which only refuse advanced cases.—Loslau, Waldhof-Elgershausen, Falkenstein, Reiboldsgrün, Moorcote, Chico Springs, Luitpoldheim, Ruppertshain, Halila, Braunwald, Sülzhayn, Reknaes, Consumption Sanatoria of Scotland, Belzig, Nordrach-on-Dee, Hauteville, Whitehaven, Laurentian, Nordrach-on-Mendip, Loomis, Davos-Dorf, Durham, Canigou, S. des Pins.

Others refuse cases in which there is excavation (Adirondack), laryngitis (de Trespoey), cardiac or asthmatic affections (Montana), chronic alcoholism (East Anglian), and the like. Others, such as Crooksbury, refuse cases which (*a*) are moribund, (*b*) have both bases affected, (*c*) active laryngeal tuberculosis, or (*d*) a temperature over 103° F. A certain number refuse all save those in a very early stage of the disease

APPENDIX V.

SHOWING THE CONDITIONS WHICH DETERMINE WHETHER PATIENTS SHOULD BE KEPT IN BED OR ALLOWED TO TAKE EXERCISE.

Compiled from answers given by the medical men at 56 sanatoriums to the questions—

(a) Under what circumstances do you prescribe rest?

(b) What form of exercise do you prescribe?

Sanatorium.	Answer.
Nordrach Colonie.	The questions require a volume and can only be determined on individual considerations. Some patients with a temperature of more than 97·8° A.M., and more than 100° P.M. taken in the rectum, must rest in bed all day and must not leave the bed before the temperature has been below these levels for a week. This, however, must not be taken as being anything like an absolute rule.
Brehmer.	Uphill exercise whenever the patient's condition permits.
Moorcote	Rest in bed for a day or two on arrival, then rest in the open for a day or two whatever the stage of disease. Rest in bed in cases of hæmorrhage, pleurisy, or rapid softening, and when the temperature is above 98·4° in the morning, or 100·4° in the evening. The last rule is modified in certain cases. Walking, gradually increasing the distance, 50 yards to five miles twice daily, unless exercise raises the temperature or pulse-rate, or causes much exhaustion or dyspnœa.
Dr. Römpler, Görbersdorf.	Before dinner and after meals exercise is forbidden. Febrile and dyspeptic patients rest on couches in open air. Slightly febrile patients may take drives.
Boserup.	Promenading when temperature under 37·7° C.
Rudgwick.	Occasionally a day in bed or rest in the open. Slow walking—two miles per hour, deep breathing exercises, and light gymnastics if temperature is normal.
Chico Springs.	Rest for high fever or hæmorrhage. All sorts of exercise when no fever exists and when these do not cause fever.
Luitpoldheim.	Bed only with fever above 38° C. otherwise rest six and a half hours daily.
Montefiore Home.	Some cases get the rest cure such as asthenia, hæmorrhage, &c. Work in garden and grounds, games, and fishing, when no fever.
Friedrichsheim.	Rest only when very weak or very feverish; particularly if patient desires it. Walking only according to strength.
Hohenbonnef.	Rest for fever, hæmoptysis. Walking and respiratory exercise.
Ruppertshain.	Rest in bed for fever. No form of exercise.
Halila (Gabrilowitch).	Absolute rest in bed for fever and hæmoptysis. Rest in recumbent position in absence of fever; when catarrhal symptoms present in lungs, no form of exercise is allowed.
Braunwald.	Febrile patients are kept in bed. Walking one and a half to three hours if temperature below 37·4° C. and pulse below 100.
Dr. Driver.	Febrile patients are kept at rest.
Sülzhayn.	All patients rest, severe cases always in bed. Walking when no fever.
Montana.	Febrile patients kept at rest.
Reknaes.	All patients rest, febrile cases always in bed. Walking.
Zarskoje.	Depends on the individual case. Exercise, avoiding fatigue.
Rosseiare.	(1) Much cough; (2) more fever than 98·6° in morning, or 100° after exercise; and (3) acute diarrhœa. Walking, when temperature has been normal for a week.
Consumption Sanatorium, Scotland.	Exercise when morning (rectal) temperature is below 99° F.
Dunstone Park.	Rest when the temperature is over 100°; this may be taken as a rough rule. Graduated walking, pulmonary exercise.
Grampian.	In bed for a day or two on arrival, also whenever temperature has reached 100° F. on previous day. Graduated exercise and climbing if temperature below 99·4° on previous day.
Holne Chase.	Rest only in febrile cases. Walking, golf, respiratory and Whiteley's exercises when morning temperature (rectal) normal, and evening temperature not above 100° (rectal).
Belzig.	Rest if temperature is above 38° C. Pulmonary exercise when disease arrested.
Nordrach-on-Dee.	Rest during pyrexial stage. Walking according to case; in some cases chest exercises.
Trespoey.	In bed when feverish. Frequent short walks.
Nordrach-on-Mendip.	Fever cases. Walking if temperature is below 37° C. and is not raised above 38° after exercise.
Vale of Clwyd.	Rest with morning temperature above 98·6°. Bed with morning temperature above 99°.
—	Slow uphill walking when morning temperature below 98·6°, or exertion temperature below 100·4°, with due regard to effects.
Nordrach-in-Wales.	Depends upon the individual and the experience of the physician. Roughly speaking, if the early morning temperature (rectal) is 98·6° or above rest is indicated. If it is 99° or over the patient must rest in bed. If the temperature rises during the day to 100·4° or over when the patient is at rest, absolute rest in bed is indicated until the temperature comes down. Walking is prescribed, but it is impossible to lay down a definite rule; depends upon individual. The amount is judged by the effect on the temperature taken immediately after the walk; if this rises to 100·4° or above the patient rests in the afternoon and next morning the walk is a shorter one. If it does not rise so high, an afternon walk is also taken and the next morning walk may be increased; this, however, is only a rough idea of it.
Rostrevor.	High temperature or hæmorrnage.
Linford.	Bed when temperature is above 37° C. in the morning and above 38° C. at night habitually, but too much cough, expectoration, general weakness, as shown by the pulse and muscular power, &c., all indicate rest or bed sometimes. Slow uphill climbing is prescribed, the amount varying with each patient's strength, condition, and temperature.
Canigou.	If the body temperature exceeds 37° C. in the morning, bed. In other cases either complete repose in the gallery or a little exercise which does not involve any fatigue or perspiration.
Guimar (Teneriffe).	Regulated climbing, beginning with 20 minutes daily. Absolute rest if temperature above 100° F.
S. des Pins.	Rest in some cases when the temperature reaches 37° C. Respiratory, gymnastic, and Sanders's exercises are advised.
Beauregard.	Fever patients are kept in bed. During menstruation, women in bed. Walking, skating, and graduated exercises.
Hauteville.	Rest when there is fever.
Adirondack.	Patients with an appreciable rise of temperature are allowed merely to walk to dining-room for meals and to sit out of doors during the febrile period in the afternoon. Rest when the temperature is above 100° and sometimes in gastritis. Amount of rest taken by more febrile patients determined by rate of circulation, nutrition, and appetite. Walking, skating, driving, if temperature not above 99·2°.
Victoria Hospital for Consumption, Edinburgh.	Those who have fever or much circulatory disturbance are kept in bed or at rest on reclining chairs or couches.
Crooksbury.	Rest in bed in cases of fever, weak circulation, hæmoptysis, great loss of weight, great weakness, rarely for dyspepsia. Walking, occasionally cycling, carriage exercise, deep breathing, and singing, if maximum temperature under 100·4°—many exceptions.
Sharon.	Febrile cases kept in bed. Exercise when no fever and condition of patient allows it; always stop short of fatigue. Respiratory exercise employed.
Winyah.	Amount of rest and exercise varied according to state of heart and of temperature.
Colorado.	At first it is often advisable to keep patients at rest.
Glockner.	Patients kept in bed when the strength does not permit of exercise.
Durtol.	Febrile cases kept at rest in fresh air.
Loslau.	Kept in bed for fever.
Dr. Turban.	Exercise when no fever.
Oderberg.	Kept in bed for fever.
Waldhof Elgershausen.	Rest when the temperature is above 37° or if there is hæmoptysis.
Falkenstein.	Absolute rest when hæmoptysis, fever, pleurisy, or acute disease is present.
Arosa.	Dr. Jacobi believes in the utility of exercise whenever the patient is sufficiently strong.
Lauretian.	Patients kept in bed when the temperature rises above 100°. Exercise is only permitted when the physical signs show that the disease is quiescent.

APPENDIX VI.

SHOWING THE CHARACTER OF THE PERSONNEL AT CERTAIN OF THE LARGER SANATORIUMS.

Proposed sanatorium at Frimley (100 beds).—A medical superintendent, two assistant medical officers; a matron, six nurses; ten female servants, three male servants.

Falkenstein (120 patients).—A medical superintendent, three assistant medical officers; managerial staff of four; one waiter to eight or ten patients; total staff, male and female, indoor and outdoor—92.

Ruppertshain (122 patients).—A medical superintdndent, two assistants, a secretary, a matron, five nurses (male and female); twenty-four male and female servants.

Harlaching (212 patients).—A medical superintendent, three assistant medical officers; a manager, two clerks, a matron, twenty-one nurses, and two male attendants; nine female and eight male servants, including engineering staff.

Krailing (120 patients).—A medical superintendent, two assistants; a matron; clerical work done at Munich; twelve nurses and three male attendants, twenty-one male and female servants.

Belzig (80 patients) and *Bleichröder* (30 patients).—A medical superintendent, two assistant medical officers; a matron, a housekeeper, a sister in office, two nursing sisters, an inspector who acts as secretary; a bath attendant for males, a laboratory attendant, a cook, four kitchenmaids, and a kitchen boy, extra help being given by girls who are taught cooking; a laundress and four under-laundresses; a porter who keeps entrance and hall clean; four maids and two menservants in the Verein-Anstalt, with two maids and a manservant in Bleichröder Stiftung. The waiting is done by menservants, but occasionally women are employed for extra work. In addition there are an engineer, two stokers, a gardener, and a gardener's help.

APPENDIX VII.

SHOWING THE DIFFERENT TYPES OF BUILDINGS EXHIBITED BY EXISTING SANATORIUMS.

(*a*) 28 large sanatoriums (8 for well to-do, 20 for more necessitous cases) in which the patients and the administration offices are placed in *one large block*. No sanatorium is included in this section which contains less than 60 beds.

(*b*) 57 sanatoriums in which the patients are housed in a *varying number of different buildings*. It will be noticed that at many sanatoriums there are a number of separate houses for the patients, although the number of these latter may be less than 20.

(*a*) *Those with a single large block* for housing patients and for administration. In this instance we do not include any sanatorium which has less than 60 beds.

8 sanatoriums for paying patients.	Date.	No. of beds.
Winyah	1878	60
Arosa	1887	65
Ashville	1898	78
Santa Catalina	1890	80
Canigou	1890	100
Hohenhonnef	1892	109
Leysin	1892	110
Schatzalpe	1900	120

20 sanatoriums for the poor.	Date.	No. of beds.
National Bournemouth	—	62
Malchow	1892	86
Loslau (£1 a week)	1898	87
Ruppertshain	1895	88
Basel (2–5 francs a day)	1895	100
Boserup	—	100
Cottbus	1900	100
Friedrichsheim	1899	100
Frimley (Brompton proposed)	1902	100
Manchester (Halkin)	1900	100
Reknaes	—	100
Wilhelmsheim	1896	100
Nicolai	1896	100
Edmundsthal (2 marks a day)	1899	103
Alland	1894	108
Oberkanfungen	1900	120
Oderberg	1897	120
Sülzhayn	1898	120
Albertsberg (£1 a week)	1897	122
Ormesson	1888	130

(*b*) *Those with a varying number of different buildings, 5 in number.*—In this section of the Appendix it will be noticed that at many sanatoriums there area number of separate houses for the patients, although the total number of these latter is as low as 20. Further, some 12 of these sanatoriums have no accommodation for patients in the administration block.

Name.	No. of beds.	How patients are housed, together with the number of patients in each building.
Maitland House.	8	4 in maintenance block, 4 in wooden building.
Hailey (future scheme).	12	A number of wooden sleeping chalets round maintenance block.
Trespoey.	14	10 in main block, 4 in annexe.
St. Andreasberg.	17	5 in one villa, 12 in maintenance block.
Altedor.	18	9 in main block, 9 in bungalows.
Whitmead Hill.	19	7 in maintenance block, 12 in another house.
Inglewood.	20	12 in maintenance block, 4 sleeping shelters, 4 more erecting.
Mendip Hills.	20	14 in maintenance block, 6 in sleeping chalets.
Woodburn.	20	10 in main block, 10 in wooden pavilion.
Crooksbury.	20	12 in main block, 8 in another.
Alderney Manor.	25	Administrative bungalow surrounded with wooden sleeping-huts.
Rostrevor.	25	13 in main block, 7 in sleeping bungalows, 5 in sleeping huts.
James Brown Sanatorium, Australia.	25	In two blocks, male and female; separate maintenance block.
National Hospital, Ireland.	34	Two houses.
Harth Forest Colonie.	35	Main block 25, 10 in small block, and a number of huts in summer.
Cotswold.	37	One stone building 14 beds, several wooden ditto 19, sleeping shelters 4.
Nordrach-on-Mendip.	37	A colony of wooden houses, largest contains 12 patients.
Montefiore Home.	40	In two blocks.
Dr. Phillipi's.	40	30 in main block, 10 in chalet.
Taitzi.	40	20 in old castle, 20 in female block.
Tonsaasen.	40 to 90	In six buildings.
Quisisana.	41	24 in main block, 7 in another, 10 in doctor's house.
Muskoka Cottage Sanatorium.	50	20 in maintenance block, 4-6 in a number of cottages.
Liverpool Hospital Sanatorium.	50	Main block a few, a number of small blocks from 4 to 6.
Königsberg.	50	36 in main block, rest in Dorchersche Barracken.
Heiligenschwendi.	52	Main block a few and two lateral pavillions.
Waldof-Elgerhausen.	59	Two houses.
Chestnut Hill.	60	A number of cottages.
Dr. Sanders's.	62	36 in main block, 36 in two other blocks.
Hygeia.	65	A few in maintenance block, two smaller blocks, and five cottages.

Name.	No. of beds.	How patients are housed, together with the number of patients in each building.
Schömberg.	65	Old sanatorium and a number of houses in the village.
Bridge of Weir.	66	One house with 26, one with 10
Nordrach Colonie.	70	In five houses.
Gabriels.	70	Number of detached cottages.
Dr. Turban, Davos.	80	In maintenance block and in three villas.
Grabowsee.	80 in winter; 160 in summer.	One house with 52, a wooden pavilion with 28, and new wooden pavilions containing 8 beds each.
Loomis.	90	One house for 16 patients and one for 25; seven cottages containing 10, 8, 8, 7, 6, 4, and 5 patients.
Schwazenbach.	90	76 in main block, 14 in a pavilion.
Adirondack.	94	The maintenance block containing a few beds and twenty one-storey cottages with 4 or 5 beds each.
Colorado.	100	Some in maintenance block, with three smaller blocks.
Reiboldsgrün.	108	In eight blocks, one containing 15 beds, another 34, another 26, another 15, another 22, another 12.
Hauteville.	110	In three pavilions.
Falkenstein.	112	One large block and one smaller block.
Laubbach.	113	Main block 67, doctor's house 14, one villa 17, two villas 15.
Dr. Römpler's.	120	Main building 100, two villas 20.
Dr. Lahmann's.	?	A number of villas, shelters for sleeping.
Mont Bonmarin.	120	In three blocks.
Boserup.	120	Two buildings.
Albertsberg.	140	122 in main block, rest in two pavilions.
Ventnor Hospital.	155	In eleven blocks, eight small blocks with 12 beds each. Maintenance block with 18, another block with 21.
Massachusetts State Hospital.	175	In 10 pavilions, five containing 20, five 8 beds.
Vogelsang.	200	40 in maintenance block, 80 in fifteen pavilions, and 80 in laundry block.
Dr. Weicker's.	275	Main block has a few beds, three blocks for 80 women, together with villas and houses.
Görbersdorf.	335	104 in main block, three villas, with 13, 24, and 16 respectively, and a number of houses.

APPENDIX VIII.

GIVING THE NAMES OF 43 SANATORIUMS IN WHICH THE KITCHEN OR DINING-ROOM OR BOTH ARE COMPLETELY CUT OFF FROM THE BLOCKS IN WHICH THE PATIENTS' BED-ROOMS ARE PLACED.

1. *Both dining-room and kitchen* in separate block or annexe—i.e., cut off from the patients' quarters in 29 sanatoriums :—

Falkenstein, Hohenhonnef, Nikolaj, Basel Davos, Linford, East Anglian, Cottbus, Nordrach Colonie, Altena, Liverpool Hospital Sanatorium, Dundee, Crooksbury, Cotswold, Nordrach-on-Dee, Massachusetts, Albertsberg, German Sanatorium Davos, Loomis, Chesnut Hill, Adirondack (all but a few beds), Dr. Weicker's Krankenheim, Harlaching, Heiligenschwendi, National Hospital for Consumption Ireland, Hailey (in future scheme). Alderney Manor, Grabowsee, James Brown Sanatorium, and London Open Air.

2. *Kitchen only* in a separate block or annexe in 7 sanatoriums.

Hygeia, Alland, Lehrecke, Ruppertshain, Alexander, Grampian, Pasteur.

3. *Dining-room only* in separate block or annnexe in 7 sanatoriums.

Canigou, Bellevue, Shotley Bridge, Maitland House, Rudgwick, Nordrach-on-Mendip, Belzig.

APPENDIX IX.

SHOWING THE NUMBER OF STOREYS WHICH THE PATIENTS MAY HAVE TO CLIMB IN ORDER TO GET TO THEIR BEDROOMS AT 89 SANATORIUMS.

(*a*) 48 sanatoriums which house less than 50 patients.
(*b*) 20 sanatoriums which house more than 50 patients and consist of several buildings.
(*c*) 21 sanatoriums (14 for the poor and seven for the well-to-do) which house more than 50 patients and consist of one large block, which may or may not, however, include the administration rooms.

Note.—In those cases in which there are several buildings of a different number of storeys we have taken the buildings which contain the greatest number of patients as being representative. Further, it may be mentioned that the number of storeys of any recent extension to existing sanatoriums which contain bedrooms for patients has seldom exceeded two, even in the case of those one-block sanatoriums mentioned under heading (*c*).

(*a*) Out of 48 sanatoriums which house less than 50 patients 25 consist of either two- or one-storeyed buildings. Many of the others were adapted from existing buildings.

(b) 20 Sanatoriums which House more than 50 Patients and Consist of Several Buildings.

Name of Sanatorium.	No. of beds.	
1. *One storey high*—		
Adirondack	94	
Grabowsee	80 winter 160 summer.	
Massachussetts	175	
Muskoka	50	
Albertsberg	140	= 5
2. *Two storeys high*—		
Heiligenschwendi	52	
Nordrach Colonie	70	
Liverpool	50	
Schwarzenbach	90	
Villiers-sur-Marne	220	
Loomis (many in one storeyed buildings)	90	
Chestnut Hill	60	
Harlaching	250	
Bridge of Weir	80	
Waldhof Elgershausen	59	= 10
3 *Three storeys high*—		
Mount Bonmorin	120	
Ventnor	155	= 2
4. *Four storeys high*—		
Römpler	120	
Falkenstein	112	
Dr. Turban's	80	= 3

(c) 21 Sanatoriums which House more than 50 Patients and consist of One Block which may or may not, however, include the Administration Rooms. Of these 14 are for the Poor, Seven for the Well-to-do.

Name of sanatorium.	Date.	Whether for the poor or not.	No. of beds.
1. *One storey high*—			
Ormesson	1888	Yes.	130 = 1
2. *Two storeys high*—			
Stiege	1897	Yes.	58
Brompton projected	1902	Yes.	100
Reknaes	Adapted.	Yes.	100
National Sanatorium for Consumption	,,	Yes.	62 = 4
3. *Three storeys high*—			
Winyah	1878	No.	60
Canigou	1890	No.	100
Oderberg	1897	Yes.	110
Manchester projected	1902	Yes.	100
Wilhelmsheim	1900	Yes.	100 = 5

Name of sanatorium (*continued*).	Date.	Whether for the poor or not.	No. of beds.
4. *Four storeys high*—			
Arosa	1897	No.	65
Ashville	1898	No.	75
Schatz Alp	1900	No.	120
Ruppertshain	1895	Yes.	88
Alland	1894	Yes.	108
Davos Dorf (new)	1898	Yes.	65
Loslau	1898	Yes.	87
Basel Davos	1895	Yes.	100 = 8
5. *Five storeys high*—			
Hohenhonnef	1892	No.	109
Leysin	1891	No.	110
Sülzhayn	—	Yes.	120 = 3

APPENDIX X.

SHOWING WHETHER BETTER RESULTS ARE OBTAINED IN ROOMS OF ANY PARTICULAR ASPECT, IN 30 SANATORIUMS IN WHICH SOME OF THE ROOMS HAVE DIFFERENT ASPECTS.

Statement.	No. of sanatoriums.	Names of sanatoriums.
No.	24	Moorcote, Nordrach Colonie, Rudgewick, Cotswold, Montefiore Home, Hohenhonnef, Ruppertshain, Braunwals, Oderberg and Gluckhauf, Falkenstein, Reknaes, Rossclare, Nordrach-on-Mendip, Nordrach-in-Wales, Canigou, Sanatorium des Pins, Montana, Linford, Adirondack, Rostrevor, Laurentian, Basle, Durham.
Yes.	6	Zarskoje on sunny side, Consumption Sanatoria of Scotland, S.; Trespoey, S.; Victoria Hospital, Edinburgh, S.; Loomis, S.; Denstone Park, S. and E.

APPENDIX XI.

SHOWING THE ASPECT OF THE MAJORITY OF THE BEDROOMS IN 72 SANATORIUMS.

Aspect of the majority of the rooms.	No. of sanatoriums.	Names of sanatoriums.
All directions.	9	Hygeia (beds in main building), Nordrach-on-Mendip, Rudgwick (6 South), Vale of Clwyd (all except East), Nordrach-in-Wales, S. des Pins; most villas at Nordrach Colonie; Harbourne, Durham (all save North).
S.	38	Sülzhayn, Ventnor, Montefiore Home, Bridge of Weir, Dundee, National (Ireland), Crookabury, London Open-air, Anstalt at Nordrach Colonie, Davos German, Rostrevor (some rooms West), Overton Hall, Cotswold, Mundesley, Nordrach-on-Dee, Hygeia (all the cottages), Dr. Sanders, Chico Springs, Loslau, Albertsberg, Oderberg, Felixstift, Fernsicht, Berka, Alexander, Nikolaj, New Davos, Montana, Braunwald, Holme Chase, Belzig Loomis, Consumption Sanatoria of Scotland, Moorcote (and west), Whitmead Hill, Sharon, Chestnut Hill, Manchester.
S.W.	3	Winyah, Hohenhonnef, half of the rooms at Rossclare.
S.S.W.	4	Bournemouth, Heiligenschwendi, half of the rooms at East Anglian, and Brompton (proposed).
Rooms with both S. and S.W. aspect.	7	Liverpool, Dunstone Park, Stourfield Park, Sunny Nook, Arosa, Hauteville, Canigou.
S.E.	8	Falkenstein, Whitehaven, Adirondack (also East), Grampian, Ruppertshain, Konigsberg, Guimar (and South), half of the rooms of Rossclare.
S.S.E.	5	Schömberg, Leysin, Linford, half of East Anglian, Brompton (proposed).
E.		Laurentian.

APPENDIX XII.

SHOWING THE CUBIC CAPACITY OF SINGLE-BEDDED ROOMS IN 28 SANATORIUMS.

Note.—In those sanatoriums in which the bedrooms are of different sizes the smallest size is taken.

Cubic feet.	No. of sanatoriums.	Names of sanatoriums.
2000-3000	11	Schömberg, Laubbach, Las Vegas, Hohenhonnef, Colorado, Canigou, Trespoey, Davos (Turban), Denver, Mt. Bonmarin, Lindheim.
1500-2000	10	Ventnor, Linford, Inglewood, Overton Hall, Rossclare, Tonssasen, Grampian, Woodburn, Dr. Michaelis, Pitkejärvi.
1000-1500	6	Nordrach Colonie (Anstalt), Brompton (proposed), White Gables, London, Open-air, Quisisana, Braunwald.
Under 1000	1	Cotswold.

APPENDIX XIII.

SHOWING THE HEIGHT OF SINGLE-BEDDED ROOMS IN 21 SANATORIUMS.

Feet.	No. of sanatoriums.	Names of sanatoriums.
14½	1	Alexander.
13	4	Falkenstein, Hohenhonnef, Inglewood, Las Vegas.
12	1	Overton Hall.
11½	2	Denver Home, Lindheim.
11	4	Woodburn, Grampian, Mont Bonmarin, Brompton (proposed) 11 and 10.6.
10	6	Cotswold, Rossclare, Colorado, White Gables, Nordrach Colonie Anstalt, Tonssasen.
9 ft. 2 in.	1	London Open-air.
9	1	Linford.
8½	1	East Anglian.

Note.—In those sanatoriums in which the bedrooms are of different heights the lowest is taken.

APPENDIX XIV.

SHOWING THE FLOOR SPACE OF SINGLE-BEDDED ROOMS IN 31 SANATORIUMS.

Square feet.	No. of sanatoriums.	Names of sanatoriums.
400-500	1	Alexander.
300-400	2	Sunny Nook, Denver Home.
200-300	5	Winyah, Colorado, Hygeia, Glockner, Denver Home.
150-200	9	Linford, Las Vegas, Mont Bonmarin, Lindheim, Woodbourn, Nordrach Colonie (Anstalt), Tonsaasen, Rossclare, Loomis.
100-150	11	Overton Hall, Grampian, London Open-air, Adirondack, East Anglian, Inglewood, Crooksbury, White Gables, Sharon, Harbourne, Brompton (proposed).
100 or less.	3	Whitmead Hill, Cotswold, Hygeia.

Note.—In those sanatoriums in which the bedrooms are of different sizes the smallest is taken.

APPENDIX XV.

SHOWING THE NUMBER OF RECREATION-ROOMS IN 52 SANATORIUMS.

In certain sanatoriums included under the first heading, such as Nordrach Colonie and East Anglian, a portion of the dining-hall is used for recreation purposes.

Recreation-rooms.	No. of sanatoriums.	Names of sanatoriums.
Dining-room only.	24	Whitehaven, Hauteville, Nordrach Colonie, Moorcote, Rudgwick, Cotswold, Friedrichsheim, Reknaes, Consumptive Sanatoria of Scotland, Rosselare, Dunstone Park, Holne Chase, London Open-air, Nordrach-on-Mendip, Nordrach-in-Wales, Guimar Hospital, Rostrevor, Crooksbury, East Anglian, Las Velgas, Alland, Krailling, Overton Hall, Durham.
One recreation-room in addition to dining-room.	17	Loslau, Dannensfels, Whitmead-hill, Braunwald, Forster's Green, Grampian, Quisisana, Rosselare, Lindheim, Dutch Davos, Vale of Clwyd, Albertsberg, Zellerfeld, Berka, Tonsaasen, Mundesley, Lehrecke.
Two recreation-rooms in addition to dining-room.	11	Boserup, Nordrach-on-Dee, Trespocy, Villiers-sur-Marne, Sülzhayn, Fernsicht, Marzell, New Davos, Leysin, Ruppertshain, Brompton (proposed at Frimley).

APPENDIX XVI.

SHOWING METHODS OF VENTILATION AT 76 SANATORIUMS.

Method.	No. of sanatoriums.	Names of sanatoriums.
Open windows alone (some having fanlights into corridors).	19	Ruppertshain, Bournemouth, East Anglian, National (Ireland), Forster's Green, Cotswold, Canigou, Durtol, Falkenstein, Laubbach, Sander's, Malchow, Tonsaasen, Reknaes Leysin, Montana, Basel, Heiligenschwendi, Braunwald.
Open windows, together with various ventilating holes in walls, below roof or above or below windows.	13	Hailey, Grampian, Woodburn, Adirondack, Hygeia, Glockner, Alland, Mont Bonmarin, Villiers-sur-Marne, Albertsberg, Stiege, Linheim, Turban.
Open windows together with simple shafts.	12	Crooksbury, Winyah, Colorado, Alland, Brehmer, Schomberg, Loslau, Oderberg, Felixstift, Altena, Harlaching, Maria.
Open window together with extractors.	10	*Shafts with hot pipes.*—Manchester Hospital, Ventnor, Villiers-sur-Marne, Nikolaj, Bridge of Wier (given up), Grabowsee, Berka. *Shaft with electric extractor.*—Krailling, Stourfield Park, Brompton (proposed at Frimley).
Open windows, together with open fires or chimneys.	11	National (Ireland), Loomis, Winyah, Mont Bonmarin, Hohenhonnef, Albertsberg, Arlen, Bridge of Weir, Alexander, Leysin, London Open-air.
Open windows with warm or cold air forced in.	11	*Plenum system abandoned.*—Ventnor, National (Ireland), Forster's Green, The Home (Denver), Villiers-sur-Marne. *Hot air abandoned.*—Victoria Hospital, Edinburgh, Oderberg, Felixstift, Altena, Quisisana, Maria.

APPENDIX XVII.

SHOWING THE KINDS OF HEATING APPARATUS USED IN 111 SANATORIUMS.

System.	No. of sanatoriums.	Names of sanatoriums.
Open fires.	17	Bournemouth, Victoria, Bridge of Weir, Hailey, Whitmead-hill, Overton Hall, Stourfield Park, Grampian, Rostrevor, Mundesley, Hygeia, Tonsaasen, Moorcote, S. des Pins, Canigou, London Open-air, National (Ireland).
Hot-water pipes and radiators.	24	Bournemouth, Crooksbury, Whitmead-hill, Nordrach-on-Mendip, Woodburn, Rostrevor, Loomis, Brehmer, Dr. Römpler's, Stourfield Park, Cotswold, Hohenhonnef, Loslau, Mundesley, Arlen, Nikolaj, Davos, Dr. Turban's, Heiligenschwendi, Braunwald, Boserup, Friederichsheim, Vale of Clwyd, Adirondack.
Low or high pressure steam-pipes and radiators.	32	Ventnor, East Anglian, Nordrach-on-Dee, Loomis, Glockner, Denver Home, Las Vegas, Alland, Reiboldsgrün, Dr. Michaeli's, Falkenstein, Nordrach Colonie, Schömberg, Malchow, Oderberg-Gluckauf, Felixstift, Königsberg, Berka, Altena, Marzell, Krailling, Harlaching, Arosa, Davos Dr. Turban's, New Davos, Montana, Basel Davos, Chico Springs, Luitpoldheim, Montefiore Home, Davos German, Ruppertshain, Braunwald, Sülzhayn, Belzig, Beauregard, Montana.
Hot air.	7	Manchester, National (Ireland), Forster's Green, Sharon, Chestnut-hill, Brehmer, Friedrichsheim.
Closed stoves, iron or porcelain.	22	Brehmer, Dr. Weicker's, Reiboldsgrün, Falkenstein, Dr. Sanders's, Dr. Weicker's Krankenheim, Stiege, Zellerfeld, Rehberg, Tonsaasen, Lindheim, Quisisana, Alexander, Maria Arosa, Davos Dr. Turban's, Dutch Davos, Military Hospital, Zarskoje, Trespocy, Nordrach-in-Wales (palace stoves), Waldhof-Elgershausen.
Electric radiator.	3	Liverpool, Nordrach-on-Dee (some rooms), Nordrach Colonie (1 villa).

In some sanatoriums two or more methods are employed.

APPENDIX XVII. (*a*).

A DISCUSSION ON THE ADVANTAGES AND DISADVANTAGES OF VARIOUS METHODS OF HEATING.

Open Fires.—Stoves.—Hot-water Pipes.—Low-pressure Steam.—High-pressure Steam.—Details of Boiler, &c., for Low- or High-pressure System.—Details of High-pressure System.

I.—OPEN FIRES.

These afford the most cheerful method of heating a room; their first cost is much less than any hot-pipe system; they keep the air fresher than hot pipes owing to chimney draught, whilst rooms in which they are used require painting less frequently than those heated with other systems. On the other hand, they give rise to dust, both when in use and when they are cleaned; they entail greater service, cost more per annum than pipes, give an unequal distribution of heat, are unsuitable for use at a sanatorium as heat is required chiefly during the night if at all, and according to Stevenson and Murphy the air in the rooms in which they are used is more highly charged with organisms.

II.—STOVES.

These afford the cheapest form of heating a room, both with regard to the initial expenditure and the annual cost; they are probably more effective heaters than open fires, and they are convenient in that they may be fed from corridor. On the other hand, they are more liable than fires to give rise to smoke, they entail greater labour of service, require more attention than, and are not so cheerful as, open fires, are liable to get out of repair, and are apt to char any dust which may come in contact with them.

III. HOT-WATER PIPES.

The advantages and disadvantages of these may be tabulated as follows:—

Advantages:

1. Less labour in service than stoves or open fires.
2. More equal distribution of heat.
3. Repairs easily made without much disturbance.
4. Annual cost slightly less than open fires, but rather more than stoves.

Disadvantages:

1. Not so cheerful as open fires.
2. First cost more than stoves or open fires, owing to the laying of pipes, boilers, &c.
3. Diminish the humidity of the air.
4. Are apt to char any dust which may come in contact with them.

A. LOW-PRESSURE SYSTEM.

For small rooms low-pressure hot-water pipes are generally more desirable than those systems which employ steam at high and unknown pressure.

Advantages—

1. The radiators in each room are simple in construction and need not be permanent fixtures. They can be fitted so as to revolve from side to side on hinges in order to enable a thorough cleansing of the floor spaces underneath them to be made.
2. They do not dry the air to anything like the same extent as high-pressure pipes.
3. The low pressure at which they work renders them less liable to leakage or bursting and hence less dangerous.
4. The temperature of the room in which they are fitted is regulated with great ease, and when they are once efficiently fitted they require little or no attention, whilst repairs are infrequent.
5. The boiler is one which burns coke, and though it must be of slightly larger dimensions than those used for high-pressure system, yet it need not be of inconvenient size.

B. HIGH-PRESSURE SYSTEM.

Advantages—

1. Owing to the high pressure at which the steam is circulating in these pipes the temperature of the room in which they are fitted can be raised much more quickly than when the low-pressure system is adopted.
2. The radiators occupy less space and are somewhat smaller than the low-pressure ones, but they must be permanently fixed and so are immovable for cleansing purposes.
3. High temperatures can be maintained, and maintained with greater ease than with the low-pressure system.
4. A relatively smaller coke-burning boiler is required than is necessary for the low-pressure system.
5. The small high-pressure pipes are slightly cheaper in first cost than the large low-pressure pipes.
6. In small rooms, 10 feet of a four-inch pipe to every 1000 cubic feet of space will give a temperature of about 55° F.

DETAILS OF BOILER, FURNACE, &C., FOR LOW- OR HIGH-PRESSURE SYSTEM.

Re smoke.—The boiler for either system is constructed to burn coke as fuel, and, if properly stoked and attended to, gives rise to very little smoke save for a few minutes when the furnace is first lighted for the day.

Re position and space.—The actual space required is not large, though the low-pressure system, as already intimated, requires a boiler of slightly larger dimensions than the high-pressure system. The boiler should be placed in an excavated room in the basement, so that the mains, carrying the hot water in jacketed pipes, can be placed along, or under, the corridors in the form of two diverging arms. The water, after circulating through the rooms, is brought by return pipes back to the boiler.

Storage of Coke.—In addition to appointing a reliable man to stoke the fire, it is advisable to provide a small room adjoining the boiler room in which a sufficient supply of coke can be stored.

DETAILS OF HIGH-PRESSURE WATER SYSTEM.

Perkins system demands the use of a series of water pipes of wrought iron and sufficiently strong to withstand a pressure corresponding to very high temperature (pipes ½ in. external diameter). A part of the circuit is coiled up and exposed to the heat of the furnace. The water circulates with great rapidity in spite of narrow bore of pipes. The temperature is regulated by fixing the proportion of the length of pipe in the furnace to the length outside. This is usually one to ten. Thus a 1500 feet long run of pipe will have in the furnace a coil of only 150 feet. The high temperature of the pipes, though useful and desirable from the fact that distribution of heat takes place to a greater extent by radiation than is the case with low-pressure systems, makes it essential that proper precautions are taken in the working of this system.

APPENDIX XVII (*b*).

GENERAL SPECIFICATION FOR THE NECESSARY ELECTRIC INSTALLATION IN THE PROPOSED SANATORIUM.

Until the site selected is known the means of producing the necessary electrical energy cannot be definitely decided upon; water power if available is, of course, to be preferred. Failing this the next best from the sanatorium point of view will be power generated by oil-engines, but it is to be feared that the cost will render this out of the question, in which case gas-engines will have to be used, the gas being produced by one of the various methods which do not entail the use of coal, unless ordinary mains are available.

Distribution.—From a convenient central position in the administration block separate cables for the lighting and heating services to be run underground to independent distribution boards, situated in a convenient position in each of the isolated patients' blocks. The circuits are then to be split up into a convenient number, each protected by a double pole safety-fuse for controlling the individual lights and radiators throughout the building. The whole of the *interior wiring*, both for the lighting and heating services, to be run in brazed and screwed tubing (the lighting and heating services to be in separate tubes) provided with suitable junction boxes let into the walls or laid under the floors. In order to prevent any accumulation of dust, in no portion of any building used by patients are the conduits to be run on the surface. The *switches* controlling the lights are to be sunk flush and covered with a plain flat cover, leaving only the button exposed, so as to collect as little dust as possible. *Fittings* of either the bracket or pendant type to be used are to be of a plain description. Pendants to consist of an enamelled tube screwed to the service tubing at the one end and to the fitting at the other, the whole arranged so that it can be readily cleaned and freed from dust, by wiping with a damp cloth, without injury to the wires.

The heating of the various portions of the building is to be done with *electric radiators* of a plain and substantial description designed to obviate, as far as possible, the accumulation of dust and at the same time to be readily removed and cleaned. Each radiator to be wound with two or more independent coils, each provided with a switch to allow the degree of warmth to be regulated as required. The radiators to be supplied by separate services to the lights and a wall socket and switch, both sunk flush, to be placed in a convenient position in each room. The flexible cord from the radiator to the wall socket must be protected by an india-rubber or other approved flexible covering not injured by damp and readily cleaned.

Kitchen.—The whole of the utensils used for cooking are to be worked by means of electricity. A specially arranged switchboard to be fitted in the kitchen supplied from the heating service, from which the various utensils will be controlled. The switchboard to be provided with a switch and fuse for each of the larger utensils, such as ovens and plate warmers which will be practically fixed, and a wall socket, plug, fuse, and switch for each kettle, saucepan, frying-pan, or vegetable steam cooker required. A ventilating fan, to extract the air from the kitchen and to remove the fumes produced by cooking, to be fitted complete with controller and switch. Each block to be supplied with a small *electric heater* for such purposes as keeping food warm.

Laundry fittings.—The usual laundry machines, including a hydro-extractor, to be worked by electric motors, either by directly coupling a small motor to each machine, or by countershafting and belts, the countershaft being driven by a large motor capable of supplying any power that may be required. A set of electric irons, together with suitable connexions for convenient use, to be provided in the ironing-room. Electric fans to extract the steam from the laundry and to provide draught to the drying-rooms to be provided.

The dining-room, recreation-room, and the other parts of the buildings mentioned in the text as requiring them, to be provided with electric fans.

APPENDIX XVII. (*c*).

SHOWING TEMPERATURE TO WHICH THE BEDROOMS ARE HEATED IN 38 SANATORIUMS.

Temperature.	No. of sanatoriums.	Names of sanatoriums.
Rooms are not heated at all.	3	Rudgwick, Guimar (unnecessary because of climate), Rosscläre, Nordrach-in-Wales.
Where little attention is paid to the temperature; in most cases this is about the same as that of the outside air.	14	Moorcote, Cotswold, Nordrach-on-Dee, Nordrach-on-Mendip, Luitpoldheim, Consumption Sanatoria Scotland, Trespoey, San. des Pins, Holne Chase, Nordrach Colonie, Canigou, Trespoey, Chico Springs, Durham.
40–50° F. in winter.	5	Boserup, 50° F.; Grampians, 43°; Linford, 40 to 50°; Basle, 48°; Whitehaven, 48°.
50–60° F. in winter.	13	Hauteville, Ruppertshain, Halila, Vale of Clwyd, Oderberg and Glückauf, Braundwald, Dunstone Park, Belzig, Hautesville, Beauregard, Montana, Crooksbury, Montefiore Home.
60° F. or over in winter.	3	Adirondack, Laurentian, Sülzhayn.

APPENDIX XVIII.

A DISCUSSION ON THE EFFICACY OF VARIOUS CHEMICAL, STEAM, AND OTHER METHODS OF DISINFECTING AND AN ACCOUNT OF THE REQUIREMENTS OF A DISINFECTING STATION.

General Methods.—Chemical Methods.—Burning.—Boiling.—Hot-air.—Various Forms of Steam.—Requirements of a Disinfecting Station.—Steam Disinfector Described.

Disinfection—that is, the complete destruction of micro-organisms and their spores—may be carried out :—

(*a*) By exposing the infected articles to the action of certain chemical substances, which act as direct poisons to the micro-organisms, such as perchloride of mercury or carbolic acid.

(*b*) By exposing the infected articles to high temperatures obtained by means of

1. Fire.
2. Boiling.
3. Hot air.
4. Steam.

(*c*) By exposing the infected materials to oxidising or to reducing agents, neither of which are practical methods on a large scale.

(*a*) CHEMICAL METHODS.

Of late years an enormous number of experiments have been made with regard to the action of various chemical substances upon tubercle bacilli. In nearly all the chemical agent is allowed to act upon the bacilli for a varying time and the subsequent activity of the micro-organisms is then ascertained by inoculation experiments. The results which have been obtained with regard to some of these chemical agents may be tabulated as follows :—

Corrosive sublimate or perchloride of mercury.—Schill and Fischer found that a strength of 2 in 1000 was not fatal to the bacilli in ordinary sputum even after twenty-four hours. Steinitz found that a 5 in 1000 strength destroyed bacilli in sputum in one and a half hours, but that a 2 in 1000 solution required three to five hours and a 1 in 1000 solution six to eight hours. He also showed by comparative tests that in the case of infected handkerchiefs sublimate was superior as a germicide to formalin or iodine trichloride. Delépine and Ransome confirmed Schill and Fischer's observations. Yersin, using cultures of tubercle bacilli in which there was no mucus or other coagulable material, showed that it took ten minutes to kill the bacilli with a solution of 1 in 1000. T. H. Elliott (1902) has shown that a strength of 1 in 500 does not destroy tubercle bacilli in the central portions of nummular sputum even after twenty-four hours. It has further been pointed out that the application of sublimate must be very freely made, as any organic matter tends to reduce it.

Carbolic acid.—Schill and Fischer found that a 5 per cent. solution of carbolic acid is not fatal to the bacilli of tuberculous sputum for at least twenty-four hours, even if the amounts of sputum and carbolic acid are the same. Gerlach found 5 per cent. carbolic acid ineffectual after twenty-four hours. Spengler found that when a 10 per cent. solution was mixed with an equal quantity of sputum some tubercle bacilli retained their virulence at the end of twenty-four hours. Yersin, on the other hand, claims to have demonstrated that infected sputum loses its virulence when exposed to a 1 per cent. solution of carbolic acid for one minute or to a 5 per cent. solution for thirty seconds. In the light of more recent work these observations of Yersin could not have been made with nummular sputum, for T. H. Elliott has shown that a solution of 1 in 20 carbolic acid does not affect the central portions of nummular sputum even after twenty-four hours. Jaeger asserts that 5 per cent. carbolic acid destroys the bacilli in dried sputum in five minutes.

Formaldehyde.—Steinitz has shown that this agent in the form of vapour is able to destroy the bacilli *in dried sputum*, but that used in solutions of 10 per cent. and 25 per cent. (of the commercial 40 per cent. formaldehyde known as formalin) ordinary sputum was not affected. Muthu has recently spoken highly of formaldehyde for room disinfection. Kenwood in 1897 published the following conclusions at the Leeds Sanitary Congress :—

1. Simple evaporation of solutions of *formic aldehyde* is inefficient when tested bacteriologically as a large proportion of gas is polymerised into trioxymethylene, which gives off aldehyde very slowly.
2. Trillat's autoclave is the best of all methods for disinfecting a room by means of formic aldehyde. A 40 per cent. solution of formic aldehyde is heated under pressure in an autoclave provided with a thermometer and a pressure gauge and a little chloride of calcium is placed in the solution. Practically all the aldehyde is given off before the water comes off as steam as the boiling point of the calcium chloride solution is well above 100° C., whilst the gas comes off below 100° C.

   The drawbacks to this apparatus are its weight and cost (£18) and the attention it requires.

   The cost for disinfecting an ordinary room apart from the cost of apparatus is about 2*s.* 6*d.* as one and a half tube of formalin is required for 3000 cubic feet of space.
3. Velvet, cloth, bronze, gilt, silk, &c., are not damaged by formic aldehyde in any form. The vapour, on the other hand, will not penetrate bulky articles such as carpets and the like.

Novy and Waite in 1898 gave the following practical directions: 1. All cracks or openings in the plaster or in the floor or about the doors and windows should be caulked tight with cotton or with strips of cloth. 2. The linen, quilts, blankets, carpets, &c., should be stretched out on a line in order to expose as much surface to the disinfectant as possible. They should not be thrown into a heap. Books should be suspended by their covers so that the pages will fall open and be freely exposed. 3. The walls and floors of the room and the articles contained in it should be thoroughly sprayed with water. If masses of sputum have collected on the floor, they should be soaked with water and loosened. No vessel containing water should, however, be allowed to remain in the room. 4. One hundred and fifty centimetres (five ounces) of the commercial 40 per cent. solution of formalin, for each 1000 cubic feet of space, should be placed in the distilling apparatus and be distilled as rapidly as possible. The key-hole and spaces about the door should then be packed with cotton or cloth. 5. The room thus treated should remain closed at least for ten hours. If there is much leakage of gas into the surrounding rooms a second or third distillation of formaldehyde, at intervals of two or three hours, should be made.

Chloride of lime.—Delépine and Ransome found that a solution of chlorinated lime of the strength of one and a half ounces to the gallon (at which percentage its use is attended by no discomfort), effectually destroys tubercle bacilli in any sputum which may have soiled the walls or furniture. These authors have been confirmed by Coates, and it is now recommended that wall papers should be disinfected by this agent. Disinfection must be repeated three or four times in succession ; by starting each time at the same corner of the

room each layer has time to penetrate into the paper and partially to dry before the next is applied. The room should be sealed and a small petroleum stove with a large basin of the disinfectant used. In the basin, which is placed above the stove, a small capsule containing strong hydrochloric acid should be immersed, as this insures the necessary acidity of the air. Disinfection is complete in three hours, but naturally destroys the paper. Clothes (except silks which are injured) may be disinfected by chlorinated lime, but must be well washed afterwards in order to remove the salt. Furniture and metal fittings must also be washed with water after use of this substance. With regard to sputum in bulk Delépine says that it is best mixed with an equal quantity of 1 in 50 chlorinated lime as weaker solutions act too slowly in the case of the tubercle bacilli.

Other disinfectants.—Both Gerlach and Spengler have shown that of 5 to 10 per cent. solutions of creolin, lysol, and aseptol, only lysol, which is comparatively expensive, is efficacious. Naugoth made emulsions of sputum and solutions (from $\frac{1}{2}$ to 1 per cent.) of iodine trichloride and found that the germs were destroyed within an hour. Steinitz, however, found that this agent was not reliable and that a 10 per cent. solution required over three hours to destroy the bacilli. Steinitz also showed that copper sulphate was inefficacious, as was hydrochloric acid in less than 10 per cent. solutions. Delépine and Ransome found euchlorine, chlorine, and sulphurous acid useless, and in this they have been confirmed by Koch and his pupils. Wood vinegar is said to kill bacilli after six hours and to lessen the unpleasant aspect of the sputum.

Summary of the value of chemical methods.—We see, then, that chemical reagents, with the exception of chlorinated lime and possibly lysol, do not act satisfactorily in sterilising ordinary sputum—i.e., sputum which is not dried in a thin layer—the reason being that the outer portion of the nummular matter is rapidly coagulated by the formation of some albuminate and so prevents the penetration of the reagent to the central portions. One word may be said here about *bread* as a means of disinfecting rooms. Loeffler showed, on the basis of Esmarck's experiments, that, if painted or papered walls are rubbed down with bread and the crumbs afterwards burnt, disinfection is efficiently carried out. Coates has, however, shown that this is only true of dry dust and that when the walls have been directly soiled with sputum rubbing with dough is useless.

(*b*) 1. *Fire-burning.*—This is a most efficient and certain method of dealing with the disinfection of valueless articles such as infected rags, papers and similar goods, old mattresses, pillows, and clothes when these are no longer required. Sputum, paper handkerchiefs and similar articles should also be destroyed by this means.

2. *Boiling.*—Moeller (1901) boiled nummular sputum for ten minutes and then found that the bacilli in the central portions infected guinea-pigs. Amongst the numerous researches on this point we may mention those of Schill and Fischer, who found that the bacilli were killed after the fluid had been boiled for thirty minutes. According to Sternberg (1887), exposure for twenty minutes to 60° C. rendered tubercle bacilli harmless. Yersin put the temperature at 80° C. For articles that will stand it, boiling water may be relied on as an efficient means of disinfection, provided, of course, that it is conscientiously carried ont. It is necessary, however, that prior to boiling the grosser dirt should be removed by a preliminary soaking in cold water because the temperature of boiling water will otherwise indelibly fix organic stains in textile substances, and thus permanently discolour the material, linen or what not. It should be remembered that leather articles cannot be boiled; these articles are always difficult to disinfect, hot air being the only applicable method. The efficiency of boiling is very much added to if the boiling-point is raised to 102° or 103° as it may be by the use of sodium bicarbonate or other substances. Sodium bicarbonate is also of value—i.e., provided that the temperature is very gradually raised—in that it dissolves or in some other way prevents the formation of the coagulation envelope, and so enables the central bacilli to be dealt with. This method must be conscientiously performed by a trustworthy individual if it is employed for cleansing sputum flasks and must be continued for at least half an hour if all micro-organisms and their spores are to be destroyed.

3. *Hot air* is not often used nowadays as a means of disinfection. It is, however, especially applicable to those articles which will not stand boiling, such as bedding, blankets, carpets, &c. Scorching not infrequently takes place owing to the prolonged exposure to which the articles must be subjected; consequently the method has been almost entirely discarded in favour of steam, which is not only more practical, but more efficient and rapid in its working.

The objections to dry heat as a means of disinfection may be enumerated as follows:—

(*a*) Slow and tedious process.
(*b*) The heat penetrates bulky articles extremely slowly, whilst the spores in the centre of infected articles are frequently unaffected.
(*c*) Scorching of goods often occurs.
(*d*) Temperature of the interior of the goods is never known for certainty.
(*e*) Great difficulty is experienced in practice in maintaining a uniform distribution of the heat.

4. *Steam*, especially when it is under pressure, penetrates bulky articles far more readily than dry heat in any form, and on this score alone is to be recommended. Schill and Fischer found that steam killed the bacilli in fifteen minutes, whilst Grancher and des Gennes state that steam is vastly superior to any chemical disinfectant. Spores and micro-organisms rapidly succumb, and this method in one or other of its various forms is now universally employed.

Disinfection by steam may be carried out in:—

(*a*) Stoves in which *steam without pressure* is used; this is a cheap and effective method in actual practice but a slow and tedious one and cannot be recommended.
(*b*) Stoves or boilers in which *steam at low pressure* (2·5 pounds per square inch) is employed. As it is impossible to obtain a temperature of above 110° C. by this means, this method is rapidly giving place to the following more practical one.
(*c*) Stoves or boilers in which *steam at high pressures* are used. A temperature of from 115° to 120° C. can be obtained in this way and any article, no matter how bulky, exposed to this temperature for one-quarter to half-an-hour is made absolutely sterile. This method is quick in application, certain in its results, easy to work, and not liable to derangement, and for these reasons is to be strongly recommended.

It should be noted that saturated and not superheated steam should always be employed because the former is more efficient and rapid in its working and penetrates more readily into bulky articles than superheated steam which practically acts like a gas. Again, the use of superheated steam involves a longer exposure of the articles in the disinfecting chamber, greater expenditure of fuel, and increased liability to damage in the case of delicate materials.

REQUIREMENTS OF A DISINFECTING STATION.

1. Whatever apparatus be employed, satisfactory provision must be made to insure, that infected articles are not allowed to become too wet or otherwise the colours will run; the disinfected articles should also be fairly dry when removed.
2. The steam used for disinfection must be "air free"; in other words, the air in the chamber must be withdrawn by some mechanism before the steam is admitted, as steam mixed with air is not nearly so efficient or reliable, from a sterilising point of view, as "live steam," the sterilising properties of which are experimentally well known.
3. The apparatus must not be too expensive, either as to cost, upkeep, or working. It should be simply devised, and not require skilled or expensive labour for its manipulation.

All the above requirements are met by the Washington-Lyon patents, under which the most efficient and modern sterilisers are built. The apparatus manufactured by Goddard, Massey, and Warner of Nottingham is perhaps the best and most practical. The apparatus consists of

a large rectangular "tubular" galvanised iron chamber, which is steam jacketed and provided at each end with a steam-jacketed door which can be securely fixed and bolted. The lower part of the steam jacket represents the boiler, underneath which the fire is placed. Steam is first raised in the jacket until a pressure of 20 pounds per square inch is reached, the excess of steam blowing off by a safety valve. The articles are now placed in a cage or receptacle which fits into the rectangular chamber and the doors are shut and secured. By means of a steam jet a stream of hot air is now drawn through the chamber for a couple of minutes. The steam is then turned on and allowed to fill the chamber until a 20-pound pressure is reached. At this temperature the articles remain twenty minutes. The steam is then allowed to escape and hot air is again drawn through the chamber by the same method in order thoroughly to dry the articles. The door is then opened and the articles are removed.

APPENDIX XVIII. (*a*).

SHOWING THE MANNER IN WHICH THE SPUTUM IS COLLECTED AT VARIOUS SANATORIUMS.

Method.	Names of sanatoriums.
Paper cups (pasteboard, &c.)	Adirondack, Sharon, Chestnut Hill, Glockner, Colorado, Chico Springs.
Various patterns of pocket flask.	Mundesley, Alland, Dr. Römpler's, Falkenstein, Laubbach, Nordrach Colonie, Ruppertshain, Reknaes, Lindheim, Alexander, Leysin, Montana, Basel, Rossclare, Vale of Clwyd, Guimar, S. des Pins, Nordrach-in-Wales, Nordrach-on-Dee, Holne Chase, Dunstone Park, Con. San. Scotland, Chico Springs, Moorcote, Davos Dutch, Dr. Weicker's, Canigou, Dr. Turban's, Winyah, Rostrevor, Felixstift, Crooksbury, Friedrichsheim, Oderberg.

In addition to the above handkerchiefs are used merely for wiping the mouth; these may be:—

Ordinary handkerchiefs or scraps of linen, as at—	White Gables, Rostrevor, Loslau, Nordrach Colonie, Grampian, and Crooksbury.
Or Japanese handkerchiefs, as at—	Adirondack (napkins), Dunstone Park, Sharon (rubber pouches), Guimar, Holne Chase.

The use of spit-cups in the bedrooms is in the majority of cases combined with pocket flasks. At Whitehaven Sanatorium, U.S.A., an excellent arrangement is employed which consists of a tin cup with sliding bottom and lined with waterproof paper. Basins fixed to walls and flushed like urinals are used at Loslau. Fixed spittoons, especially when on the ground, are open to several objections, as many patients are not sufficiently expert in their use. Spit-cups should not be of glass or porcelain, as these readily break, and several instances in which inoculation has occurred in this way have been recorded. Porcelain is also liable to crack in the frost.

APPENDIX XVIII. (*b*).

SHOWING THE FLUID USED IN RECEPTACLES FOR SPUTUM AT 27 SANATORIUMS.

Fluid.	Names of Sanatoriums.
Water.	Las Vegas, Dr. Römpler's, Dr. Driver's, Laubbach, Schomberg, Alexander, Loslau, Ventnor.
Corrosive sublimate.	Chestnut Hill, Hygeia.
Lysol.	Falkenstein, Hohenhonnef (lysol 1 per cent. and soft soap, 5 per cent.), Dr. Weicker's, Altena, Braunwald, Dr. Sanders.
Carbolic acid (5 per cent. to 20 per cent.).	Victoria Hospital, Edinburgh, Overton Hall, Quisisana, Moorcote, Cons. San. of Scotland, Dunstone Park, Nordrach-on-Dee, Nordrach-in-Wales, Montefiore Home, Durham.
Formalin.	Grampian.
Carbonate of soda.	S. des Pins.
Chloride of lime.	Whitehaven.

APPENDIX XVIII. (*c*).

SHOWING THE WAY IN WHICH THE SPUTUM IS DEALT WITH AT 65 SANATORIUMS.

Method.	No. of sanatoriums.	Names of santoriums.
Burnt without other treatment.	25	Mundesley, Adirondack, Sharon, Chestnut Hill, Winyah, Glockner, Colorado, Hygeia, Alland, Loomis, National Ireland, Whitehaven, Ruppertshain, Krailling, Tonsaasen, Laurentian, Rostrevor, Rudgwick, Moorcote, Chico Springs, Sülzhayn, Guimar, San. for Con. Scotland, Grampian, Belzig.
Burnt after being mixed with—	11	
(*a*) Peat mould		Alland, Oderberg, and Ruppertshain.
(*b*) Sawdust ...		Canigou, Rossclare, Linford, Vale of Clwyd, Nordrach Colonie, Cotswold, Crooksbury.
(*c*) Ferrous sulphate ...		Tonsaasen.
Boiling	3	Malchow (with soda), S. des Pins (mixed with a concentrated solution of carbonate of soda, boiled for forty minutes, and then poured into tank with sulphate of iron and lime), at London Open-air (kept in a tank into which steam is passed when the laundry is in use).
Poured into w.c. or sinks	17	Dr. Driver's, Dr. Michaeli's, Hohenhonnef, Laubbach, Grabowsee, Albertsberg, Rehburg, Arlen, Reknaes, Ventnor, Victoria Edinburgh, Lindheim, Quisisana, Dr. Turban's, Dutch Davos, Trespoey, Waldhof-Elgershausen.
Poured into w.c. or sinks after previous treatment* by—	5	
(*a*) Boiling ...		Reknaes, Trespoey, Halila (boiled with sublimate).
(*b*) Ferrous sulphate ...		Lindheim.
Treated with lysol	4	Altena, Braunwald, Dr. Weickers, Dr. Sanders.

* Apart from any antiseptic which may be used in the flask.

At Nordrach-in-Mendip the sputum is placed in the septic tank.

APPENDIX XVIII (*d*).

GIVING EXAMPLES OF THE MANNER IN WHICH THE RECEPTACLE FOR THE SPUTUM IS TREATED AT 27 SANATORIUMS.

Method.	No. of sanatoriums.	Names of sanatoriums.
Burnt.	7	Adirondack, Glockner, Whitehaven, Sharon, Chestnut Hill, Chico Springs, Colorado.
Boiled or subjected to steam.	7	Montana, Moorcote, Canigou, Oderberg and Glückauf, Hauteville, Boserup.
Boiled with bicarbonate of soda.	3	Las Vegas, Linford, and Nordrach Colonie.
Cleansed with various antiseptics.	10	The Home Denver (sublimate), Königsberg (sublimate), Dr. Turban (sublimate and sodium chloride), Leysin (lysol and sublimate), Chestnut Hill and White Gables (porcelain cups for paper receptacle treated with carbolic), Whitehaven (tin cup for paper receptacles treated with carbolic), Falkenstein (lysol), Hohenhonnef (lysol), and Leysin (carbolic).

In many, as at the London Open-air Sanatorium, the receptacles are merely washed out with water.

APPENDIX XVIII. (*e*).

SHOWING THE WAY IN WHICH THE ROOMS ARE DISINFECTED AT VARIOUS SANATORIUMS.

Method.	Names of sanatoriums.
Moist cleaning is used in nearly all, as at	Dr. Michaelis's, Albertsburg, Dr. Turban (soap and water), Basel (soap and water), Waldhof-Elgershausen, Loslau, Nordrach Colonie, Oderburg and Glückauf, Reknaes, Moorcote, Grampian, Rostrevor, New Davos, Overton Hall, Laurentian, Rehburg, Durham co., Nordrach-on-Mendip, Halila, Hohenhonnef, Whitehaven, Inglewood, Vale of Clwyd, Montefiore Home, Consumption Sanatoria of Scotland, Nordrach-in-Wales, Adirondack (soap and water), Rosseclare (soap and water), Boserup (soap and water).
In many various disinfectants are used in addition for disinfecting the walls, floors, and furniture.	
1. Corrosive sublimate.	Trespoey (spray), Lindheim, Quisisana, Braunwald, Chico Springs, Linford, S. des Pins, Nordrach Colonie (from time to time).
2. Carbolic acid.	Rudgwick, Dunstone Park, Holne Chase, Adirondack (from time to time).
3. Lysol.	Grabowsee, Malchow.
4. Chloride of lime.	Sharon.
5. Soda solution.	Davos Dutch.
6. Sulphur.	Rudgwick, Rossclare.
7. Bread to walls, &c. (afterwards burnt).	Hohenhonnef, Laubbach, Arlen, Lindheim, and Tonsaasen.
8. Creolin.	Crooksbury and Schömberg.
9 Various preparations of formalin (when patient goes).	Mundesley, Chestnut Hill, Winyah, Hygeia, Glockner, Chico Springs, Trespoey, Canigou, Adirondack, The Home Denver, Las Vegas, Alland, Dr. Römpler's, Dunstone Park, S. des Pins, Falkenstein, Dr. Weickers, Schömberg, Davos New, Davos Dutch, Grampian, Beauregard, Montana, Crooksbury, and Basel.

At most sanatoriums the rooms are periodically fumigated, re-papered, or re-varnished, &c., as an additional precautionary measure.

APPENDIX XVIII. (*f*).

SHOWING THE WAY IN WHICH THE LINEN AND BEDDING ARE DISINFECTED AT 54 SANATORIUMS.

Linen.

Method.	No. of sanatoriums.	Names of sanatoriums.
Boiled.	24	Sharon, Winyah, Dr. Michaeli's, Laubbach, Waldhof-Elgershausen, Nordrach Colonie, White Gables, Loslau (after soaking in lysol), Malchow, Albertsberg, Oderberg and Glückhauf, Lindheim, Dr Turban's, Montana, Rudgwick, Crooksbury, Adirondack, Dr. Weicker's, Moorcote, Nordrach-in-Wales, Braunwald, Whitehaven, Chestnut Hill.
Boiled with sodium bicarbonate.	5	Braunwald, Canigou, Loslau, Sülzhayn, Laurentian (also treated with formalin).
Steamed.	24	Hygeia, The Home Denver, Las Vegas, White Gables, Arlen, Davos Dutch, Alland, Canigou, Trespoey, Dr. Römpler's, Reknaes, Belzig, Dr. Driver's, Dr. Michaeli's, Falkenstein, Hohenhonnef, Quisisana, Nordrach-on-Dee, Schömberg, Grabowsee, Halila, Ruppertshain, Alexander, Basel.
Treated with hot air.	1	Montefiore Home.

At Nordrach-in-Wales specially soiled linen (e.g., by upsetting of spittoons) is allowed to soak in a disinfectant and then burnt.

Bedding.

Method.	No. of sanatoriums.	Names of sanatoriums.
Treated with hot air.	3	The Home Denver, Reknaes, Montefiore Home.
Steamed.	5	Falkenstein, Rehburg, Montana, Dr. Michaelis (Basel).
Treated with corrosive sublimate and soda.	1	Tonsaasen.

APPENDIX XVIII. (*g*).

SHOWING THE WAY IN WHICH THE CROCKERY AND SILVER (FORKS, &C.), ARE DISINFECTED AT 26 SANATORIUMS.

Method.	Names of sanatoriums.
Boiling.	Winyah, Beauregard, Oderberg and Glückauf, Nordrach-in-Wales, Waldhof-Elgershausen, (sterilising apparatus), Adirondack, Falkenstein, Cotswald, Crooksbury, Moorcote, Rudgwick, Loomis, Basel, Belzig.
Boiling with soda.	Braunwald, Grampian (also antiseptic soap), S. des Pins, Canigou, Reknaes, Loslau, Rosseclare, Rostrevor.
Treated with corrosive sublimate.	Beauregard (glasses only).

At the Consumption Sanatoria for Scotland the patients wash their own glasses, whilst at Dunstone Park laryngeal cases have special glasses.

APPPENDIX XVIII. (*h*).

SHOWING THE PRECAUTIONS WITH REGARD TO THE USE OF MILK WHICH ARE TAKEN AT VARIOUS SANATORIUMS.

A pure milk may be obtained by :—

1. Efficient veterinary supervision, as at Moorcote, Sanatorium des Pins, Rudgwick, and the Grampians.
2. Tuberculinisation of cows as at Hohenhonnef, Cotswold, Falkenstein, Nordrach-on-Dee, Sanatorium des Pins, Rostrevor.
3. By sterilisation by means of heat, as at Ruppertshain, Rossclare, Reknaes, Dunstone Park, Holne Chase, Loslau, Belzig, Nordrach-on-Mendip, and Crooksbury.

APPENDIX XIX.

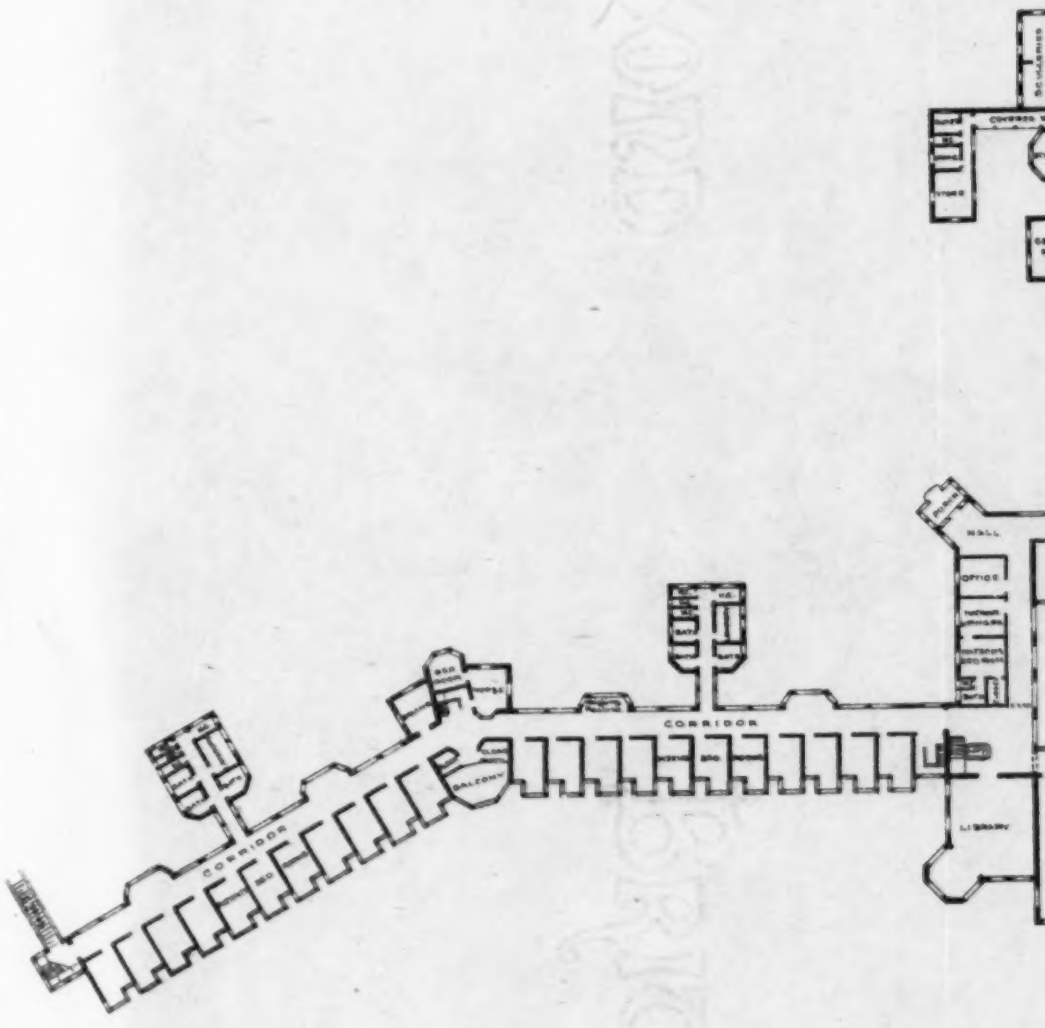
A SPECIFICATION OF THE SANITARY ARRANGEMENTS IN PROPOSED SCHEME.

This specification is drawn up on the idea that the drainage of the proposed sanatorium will be discharged into an ordinary sewer in main road (with proper intercepting trap and inspection chamber); if such a sewer, however, is not available, the sewage will be discharged into a septic "tank" constructed on the principle of the Septic Tank Syndicate. In this latter case the bathroom, housemaid's, and other slops will be taken by a separate system of drains provided that Kenwood's system of irrigation is adopted.

The water supply for cooking and drinking purposes to be quite separate and distinct from all water-closet or similar supply.

The sanitary arrangements in each tower to be on the most approved system so as to allow the complete removal of all excreta and all liquid refuse, all fittings being properly trapped to avoid the entrance of sewer-gas into the building but without interfering with the free passage of a current of fresh air through all soil- and waste-pipes.

Water-closets.—The water-closets apparatus will be of an improved "wash out" type or a "valve closet" with the traps connected by branches into a main stack of heavy lead soil-pipes which at the foot will join the iron (or glazed stoneware) drain. The apparatus will be flushed with three



GROUN

TO ILLUSTRATE DR. LATHAM'S ESSAY.

BLOCK FOR 88 MALE AND FEMALE PATIENTS.

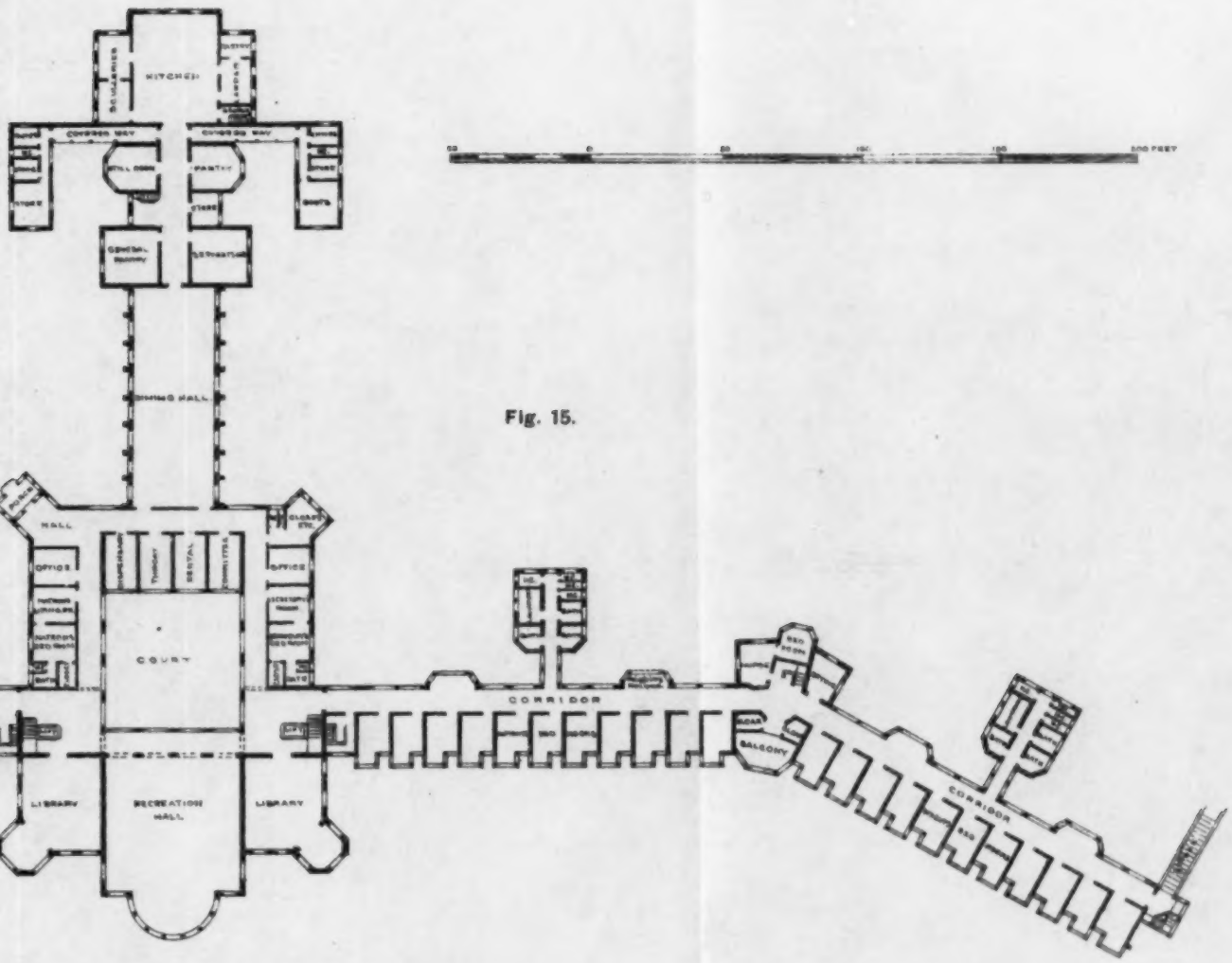
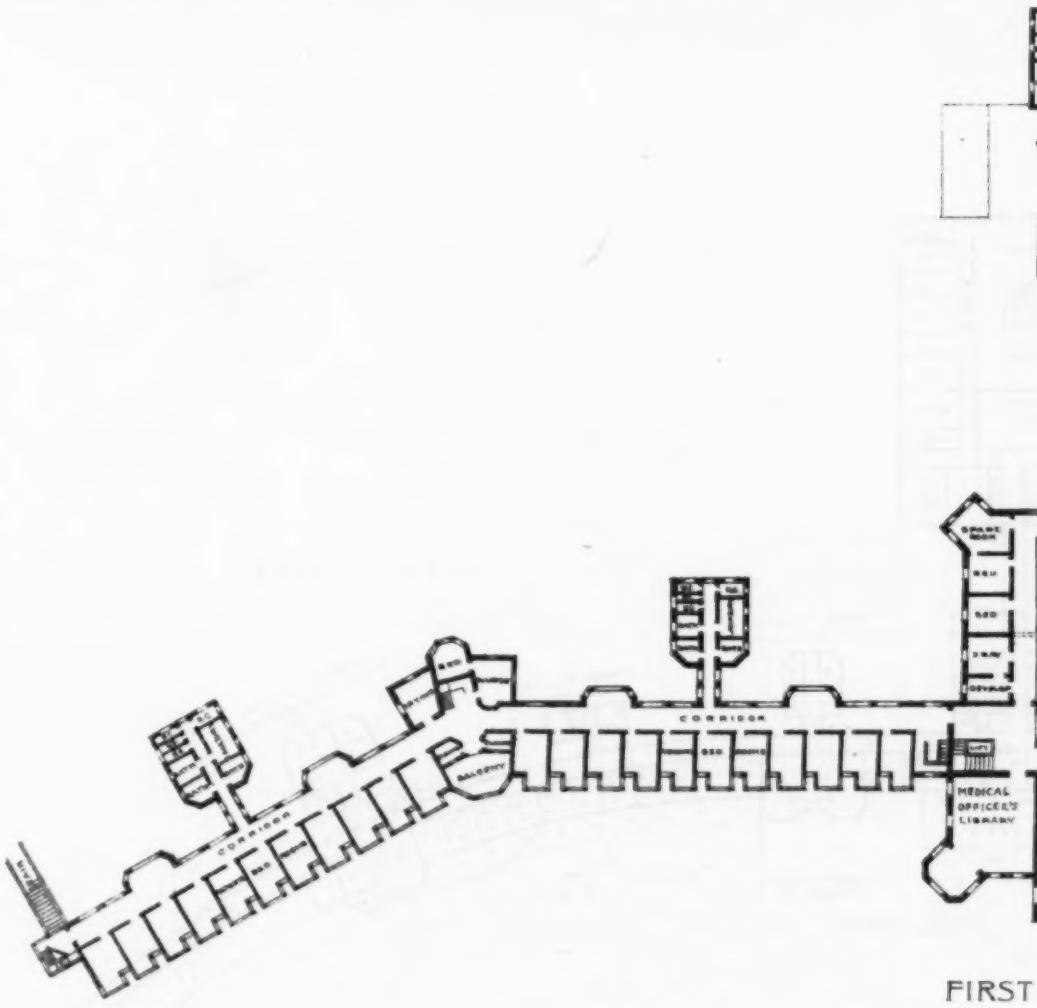


Fig. 15.

GROUND FLOOR PLAN.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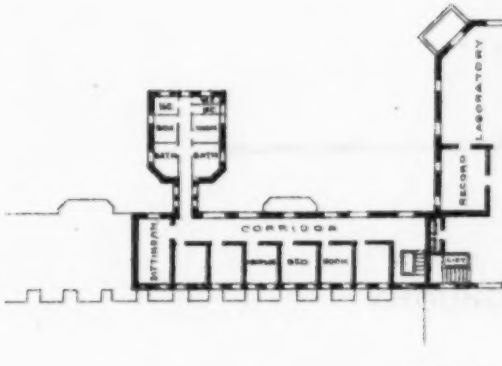
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SECON

TO ILLUSTRATE DR. LATHAM'S ESSAY.

BLOCK FOR 88 MALE AND FEMALE PATIENTS.

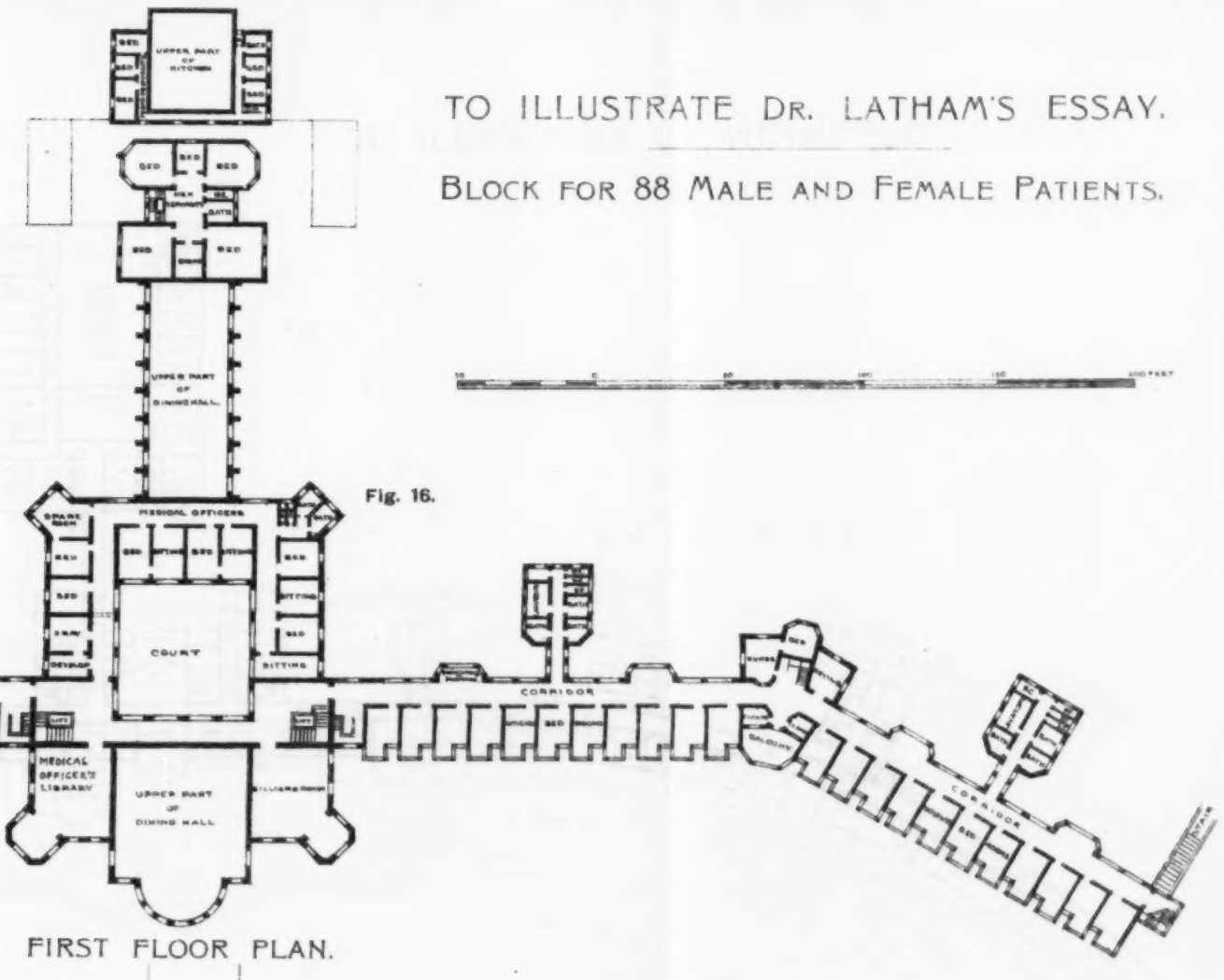


Fig. 16.

FIRST FLOOR PLAN.

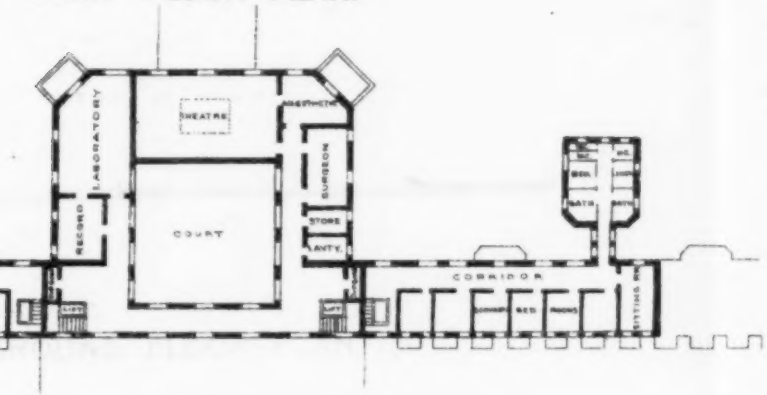
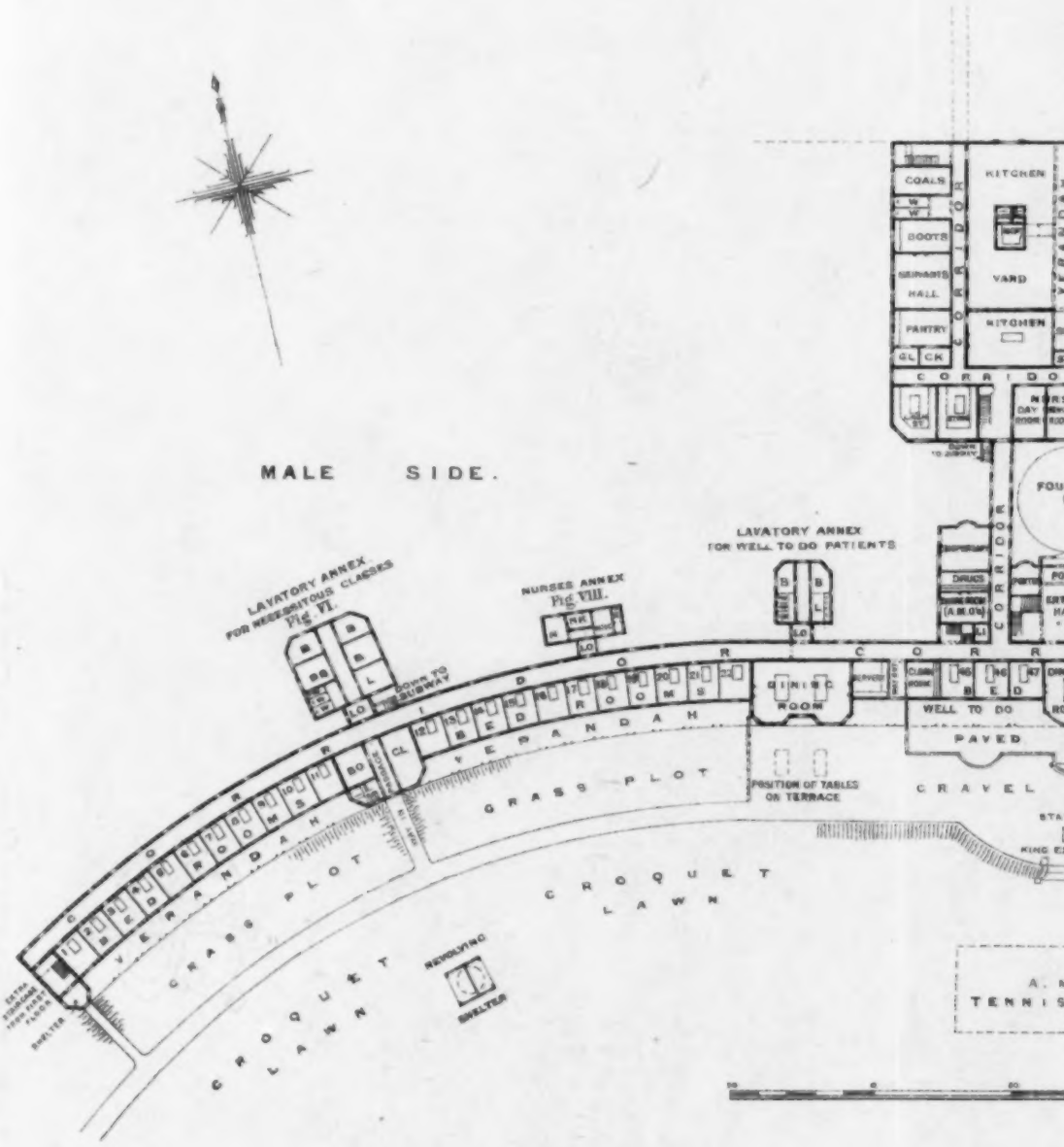


Fig. 17.

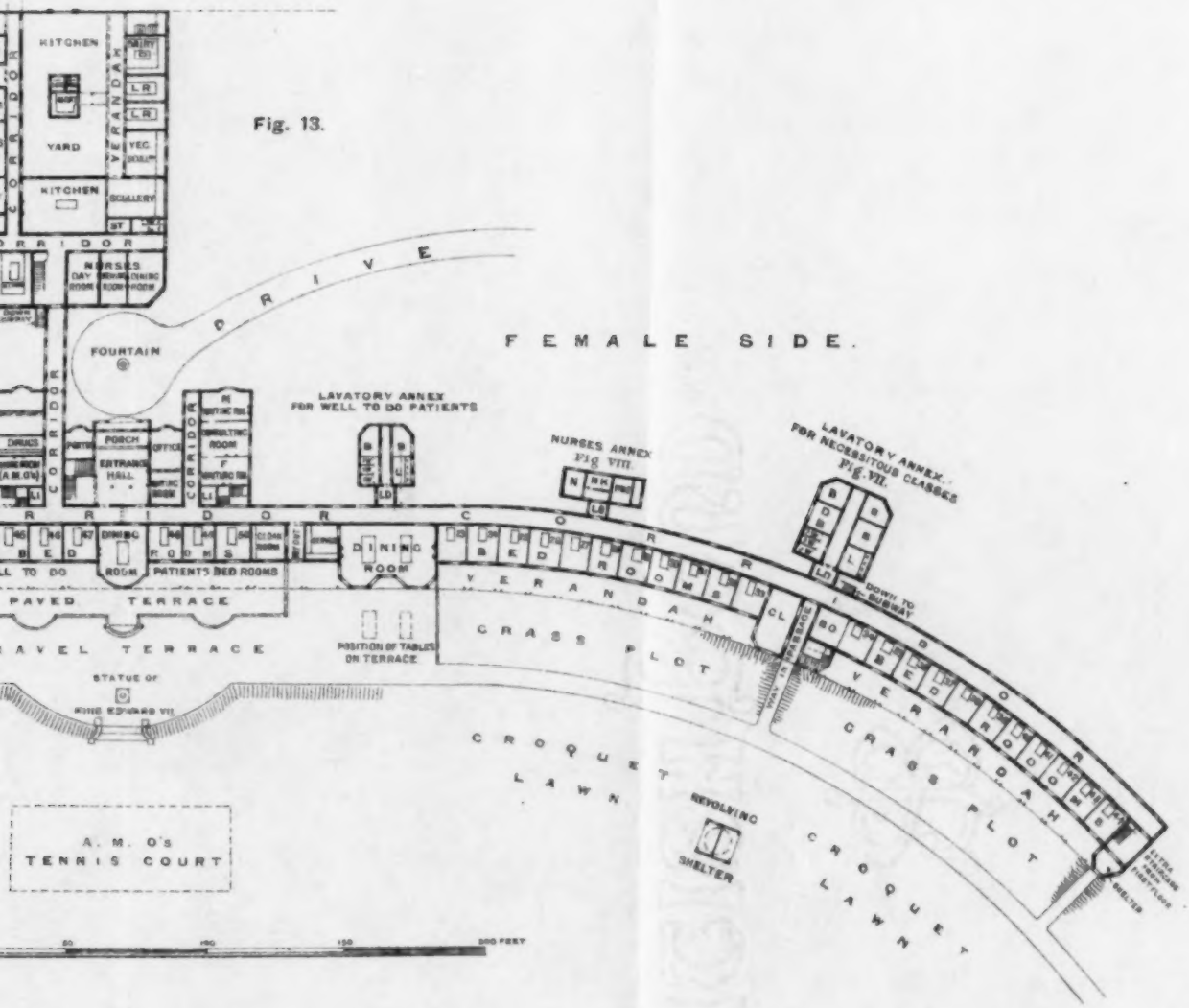
SECOND FLOOR PLAN.


MALE SIDE.
LAVATORY ANNEX FOR RESPECTABLE CLASSES Fig VI.
NURSES ANNEX Fig VIII.
LAVATORY ANNEX FOR WELL TO DO PATIENTS
DOWN TO SUBWAY
KITCHEN
COALS
BOOTS
SERVANTS HALL
PANTRY
YARD
KITCHEN
GL
CK
CORRIDOR
DRUGS
QUINICO ROOM
WELL TO DO
PAVED
GRAVEL
POSITION OF TABLES ON TERRACE
VERANDAH
GRASS PLOT
CROQUET LAWN
REVOLVING SHELTER
SHELTER

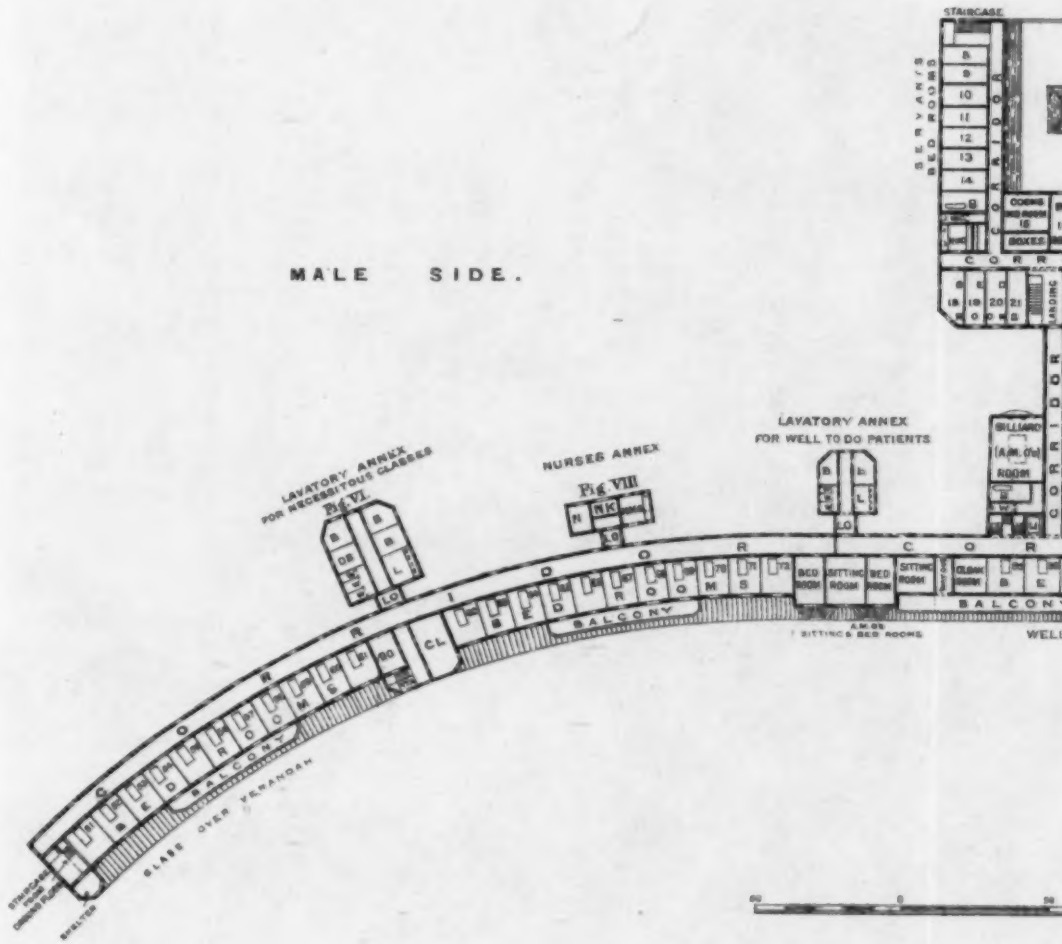
GROUND FL

TO ILLUSTRATE DR. WETHERED'S ESSAY.

Fig. 13.



UND FLOOR PLAN.


MALE SIDE.
STAIRCASE
SERVANTS BED ROOMS
CORRIDOR
COOKING AND ROOM
BOXES
LAVATORY ANNEX FOR NECESSITOUS CLASSES
Fig VI.
NURSES ANNEX
Fig VIII
LAVATORY ANNEX FOR WELL TO DO PATIENTS
BILLIARD ROOM
BALCONY
BED ROOM
SITTING ROOM
GLASS OVER VERANDAH
FIRST

TO ILLUSTRATE DR. WETHERED'S ESSAY.

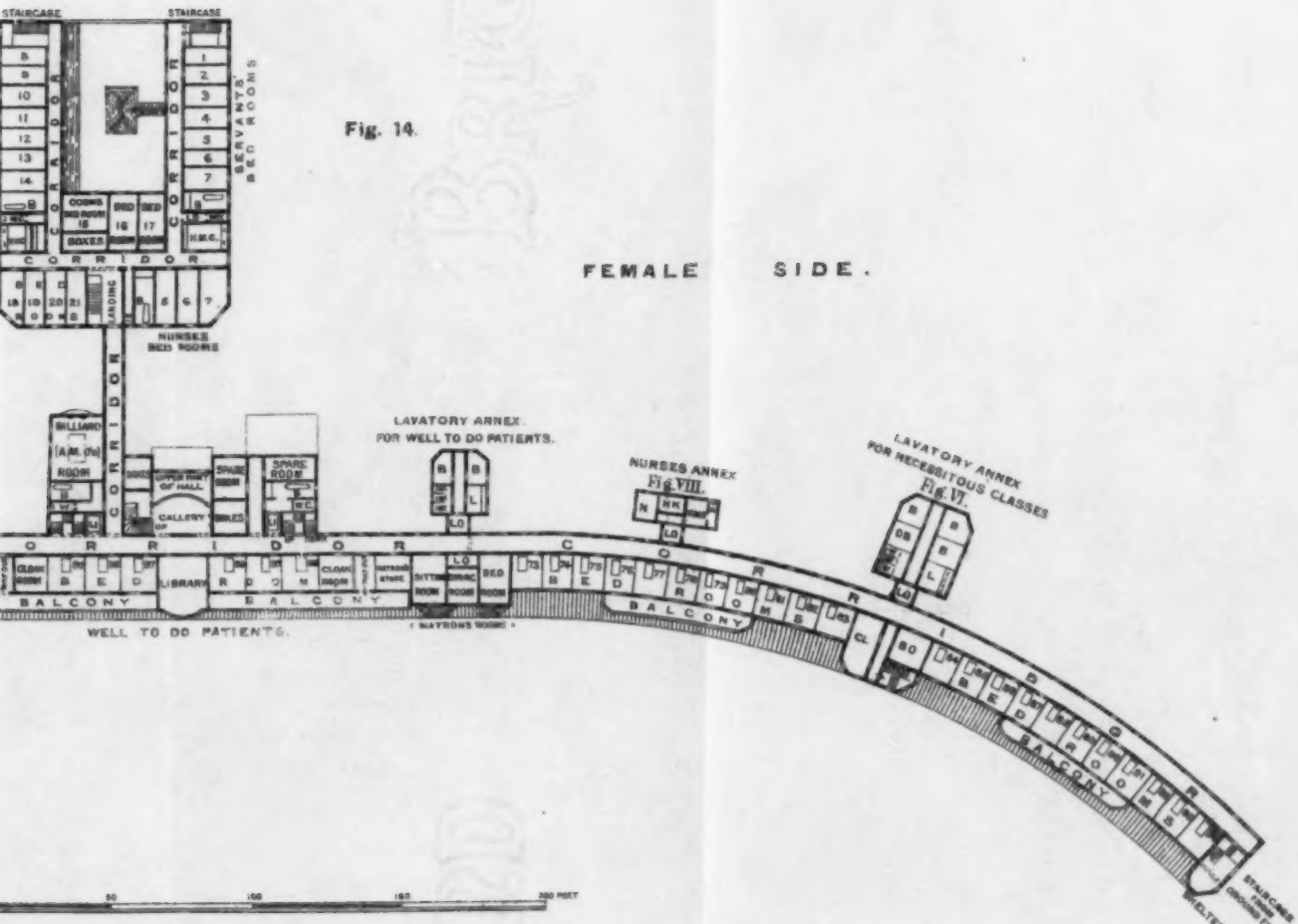
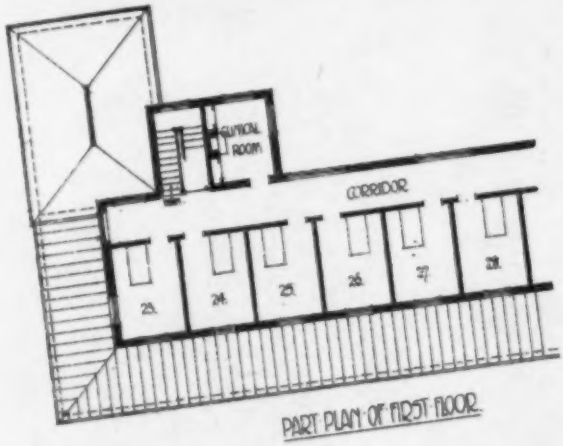


Fig. 14.

FEMALE SIDE.

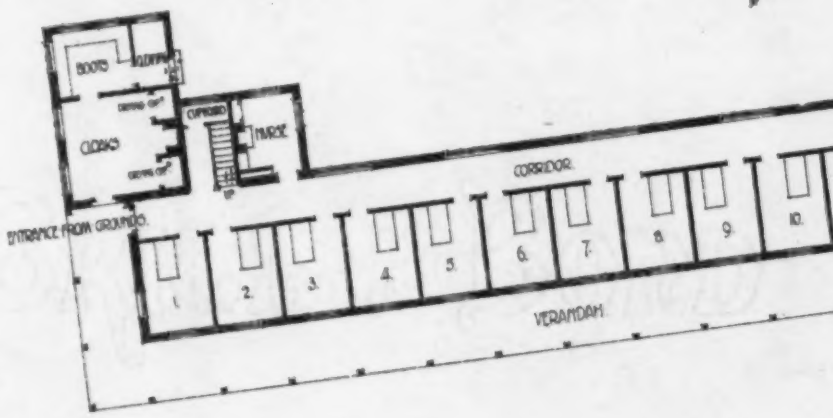
FIRST FLOOR PLAN.



PART PLAN OF FIRST FLOOR.

SANATORIVM · WEST

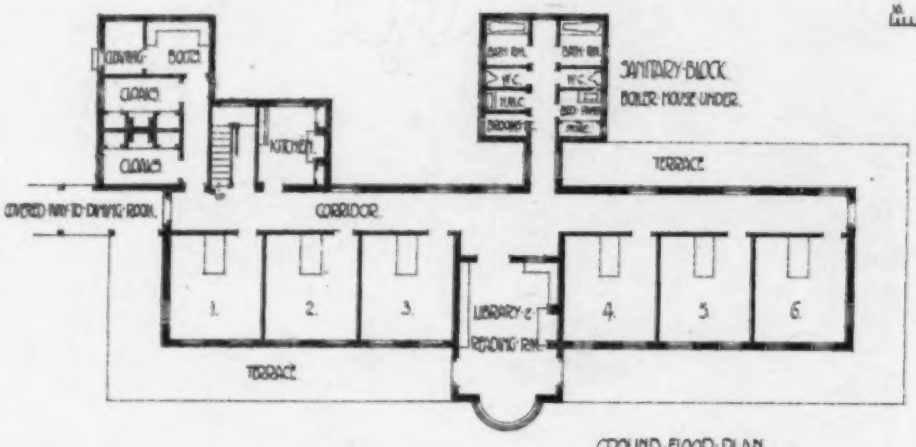
SCALE OF FEET.



GROUND FLOOR

THE · ANNE

SCALE OF FEET.

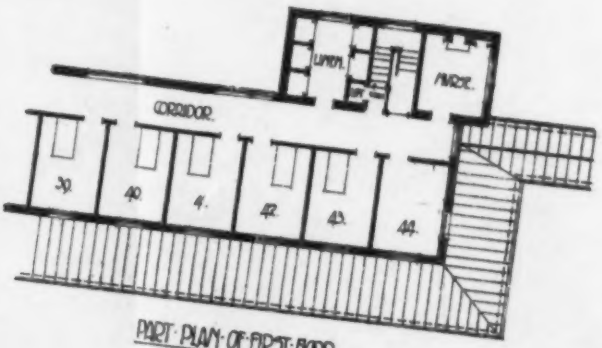


GROUND FLOOR PLAN.

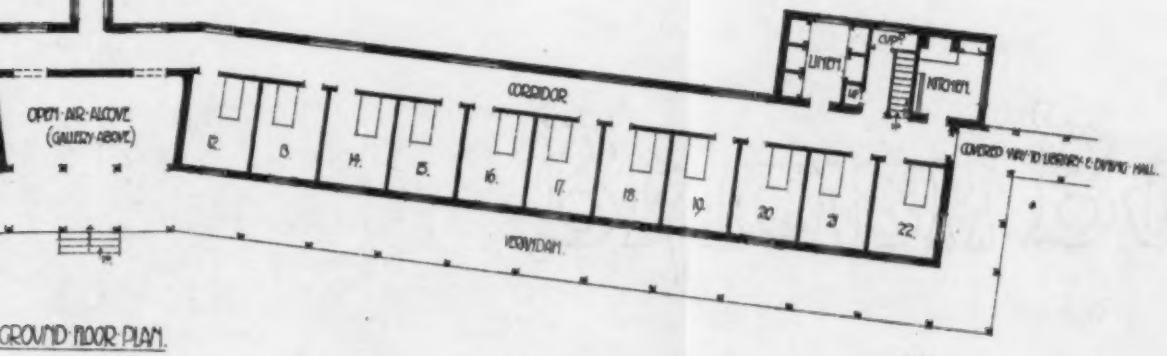
TO ILLUSTRATE DR. MORLAND'S ESSAY.

WEST WING.

SCALE OF FEET.



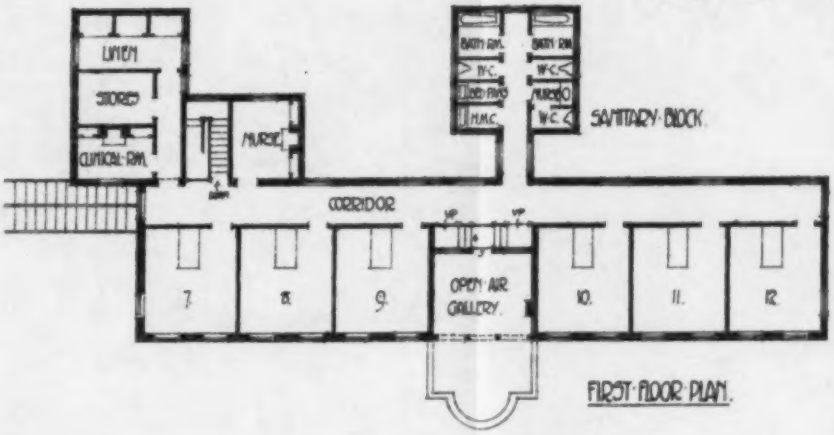
PART PLAN OF FIRST FLOOR.



GROUND FLOOR PLAN.

E ANNEXE.

SCALE OF FEET.



FIRST FLOOR PLAN.

gallons of water after each use from a water waste-preventing cistern fixed six feet above the seat. The soil-pipe will also be carried up above the level of the flat roofs as a ventilating shaft to allow of a free passage of air to a sufficient height to prevent any escaping sewer gas becoming a nuisance to anyone on the roof. Proper two-inch lead anti-syphonage pipes will be taken from the back of each trap to prevent the water seal in the trap being disturbed by the suction of air when other apparatus is in use, and will also be carried up well above the roofs.

Sinks.—The housemaid's sinks will be of an improved type of glazed stoneware, having special provision for thoroughly cleaning bed-pans, &c., and accommodation for general washing up. They will be trapped and connected by branches into a main stack of heavy lead soil-pipes in a similar manner to the water-closets and join the iron (or stoneware) drain at foot and be carried up as a ventilator above the level of the flats. These will also have anti-syphonage pipes.

Baths.—Each floor of the sanitary tower to have a Doulton's vitreous enamel bath together with shower baths (the number of these varying with the individual blocks), trapped, drained, and ventilated as described for sinks. These pipes will discharge over an open length of channel terminating in a gully, and not be connected direct to the drains, thus preventing all possibility of sewer-gas entering the pipes. The joints in the waste-pipes to be formed with indiarubber expansion rings, to allow of the expansion and contraction of the lead pipe. The tile floors of the shower-bath rooms will be given a slight fall to a trap and waste in the floor, connected into the bath waste with proper ventilation.

Lavatory.—The lavatories will be of white glazed stone-ware. They will be trapped, drained, and ventilated in a similar manner to the baths.

Kitchen and scullery sinks.—Special provision will be made for the removal of all grease and other matter by the adoption of proper grease traps having a periodical flush from automatic flushing tanks.

The drainage.—The soil-pipes and gullies will be connected to heavy iron drain-pipes, treated internally with Dr. Angus Smith's solution and laid on a bed of cement concrete, the whole laid in straight courses with even falls and having proper inspection chambers at every change of direction or at points of junction. The walls of the chambers will be built in brickwork in cement, and properly rendered in cement; the bottom will be formed with half channel pipes and the tops finished with galvanised iron manhole covers and frames. *Fresh-air inlets* will be supplied to the drains so as to produce a constant current of fresh air passing through and up the soil-pipes. *Suitable automatic flushing-tanks* will be fixed in proper positions to cleanse and disinfect soil-pipes, wastes, and drains.

APPENDIX XIX. (*a*).

THE METHOD OF DEALING WITH THE DISPOSAL OF SEWAGE WHEN THE WATER CARRIAGE SYSTEM IS NOT AVAILABLE AND CONSERVANCY METHODS ARE NOT USED.

The Rivers Pollution Prevention Act makes it illegal to discharge sewage direct into a stream, hence the sewage must be purified. This may be accomplished by

(*a*) The biological method.
(*b*) Subsidence.
(*c*) Straining.
(*d*) Precipitation.

(*a*) *The septic tank system or biological method* of sewage treatment has for its object the purification of sewage by natural means and the avoidance of the cost entailed by artificial treatment. The process adopted may be briefly described under two heads. First, the destruction of the solid matters as such, and secondly, the purification of the dissolved polluting matters. The former is brought about in a receptacle called the septic tank which consists of a chamber containing about one day's flow of sewage, more or less according to the strength of the latter. It is generally covered and the exclusion of air is completed by the submergence of the inlet and outlet pipes so as to deliver, and draw off respectively, below the surface of the sewage. Instead of filling and emptying the tank alternately as is done with a precipitation tank the sewage is allowed to run through it continuously, and it is not emptied from one year's end to another. Although the flow through the tank is continuous, the motion is so slow that its contents are practically at rest. In this way ample opportunity is afforded for the separation of the solid matter, the heavier substances sinking to the bottom while lighter bodies float to the surface. Seeing that all these are encouraged to enter the tank instead of being kept back by screens, as is done where precipitation is resorted to, a thick scum soon forms over the surface of the liquid. Various races of liquefying bacteria, known as "anaerobic," are thus afforded the conditions most favourable to their growth and activity—viz., an abundant food-supply, darkness, an equable temperature, absence of atmospheric oxygen, and a steady current to wash away the products of decomposition. So well do they do their work that tanks have been in use for close on four years without requiring to be cleaned. The floor of the tank is covered with a fine deposit, largely mineral; but the bulk of this is trifling compared with that of the solid matter which has been brought in with the sewage. The second process—viz., purifying the liquid effluent—is, like the preliminary liquefaction, performed by bacteria. These, however, are aerobic. They are accordingly housed in a very different fashion, their workshops being known as the "filters." A plentiful supply of oxygen is essential to the purification of the effluent. The dark-coloured fluid which escapes at the further end of the tank over a weir is therefore discharged into a series of large traps, or aerators as they are called, which mechanically cause the water to entangle or dissolve large quantities of air.

The aerated effluent now passes on to a filter charged with some granular material such as coke, burnt ballast, or broken clinker, the interstices of the material being filled with the liquid to be purified. The filter is kept full for a certain period and the contents are finally drawn off. The liquid descending through the filter is brought into close contact and thoroughly mixed with the air which the latter contains, and is purified by the agency of the aerobic bacteria therein. In addition to promoting the admixture of liquid and air the filtering material serves the further important purpose of affording a resting place for the bacteria which would otherwise be washed out at every discharge. To secure the utmost efficiency these organisms must be brought as near their work as possible; in other words, the interstices should be narrow so that no portion of the liquid may be far from the filtering medium. The latter should be in small pieces so as to afford the maximum superficial area; but, on the other hand, it should not be so fine as to prevent the liquid from passing away freely. In order to secure efficient working and at the same time to maintain the filters in a proper condition they must be employed in regular rotation. For this purpose an automatic alternating gear is introduced in which the various stages of filling, resting when full, discharging, and aerating are brought about in turn by means of an overflow from the filter last filled. The whole installation is thus rendered completely automatic, the attention required being reduced to an occasional visit of inspection, oiling the bearings of the gear at long intervals, and throwing the spare filter into work in place of one of the others every second or third day.

Speaking generally, the complex organic substances present in the crude liquid are broken down in the septic tank into simple forms of which ammonia, carbonic acid gas, nitrogen, hydrogen, and marsh gas may be mentioned. Most of these pass off as gas, but the ammonia which is dissolved in the tank effluent requires further treatment by oxidation. This is accomplished in two stages, the first producing nitrous acid, and the second resulting in the formation of nitric acid. The nitric acid attacks the alkalies present, and appears in the filtrate as nitrate of soda or nitrate of calcium. Thus the nitrogenous matters to which the sewage chiefly owes its offensive character are finally converted into harmless salts which cannot pollute a river or give rise to secondary decomposition. The possibilities opened up by the bacterial methods of purification have led to the introduction of new standards, to which a final effluent is called upon to conform. Formerly all that was required of an effluent was that the impurity which it contained should be brought within certain prescribed limits in order that it should not greatly pollute the river into which it was discharged. Nowadays it is not enough that the effluent shall not pollute the stream which receives it; it is expected to be capable of purifying the latter. As the effluent from the

tanks is practically free from solids in suspension, it is in the best condition for either irrigation or filtration.

The biological method of dealing with sewage is undoubtedly the most scientific and the most practical of those in use at the present time. As, however, other methods are employed at certain sanatoriums we give a brief description of them.

(*b*) *Subsidence.*—The crude sewage is allowed to settle in large tanks; the suspended matter falls to the bottom and a clear supernatant fluid results which is decanted off. At the best this is an obsolete and slow process as it demands the use of large tanks which involve great expenditure in their construction and a considerable amount of land.

(*c*) *Straining.*—Attempts have been made from to time to purify sewage by straining off its solid ingredients through beds or filters of gravel, ashes, or charcoal. The frequent choking of the filters involves their continuous renewal at great cost. Again, the fact that the sewage so treated is merely clarified and is not deprived of its soluble polluting ingredients, at once stamps this method as being inadequate.

(*d*) *Precipitation.*—Many years ago it was recognised that the addition of certain chemical substances to sewage, prior to its entering the settling tanks, caused a rapid and copious precipitation of its suspended matters. The knowledge of this fact led to many experiments with a large number of different chemical materials. After a prolonged practical trial it is now known for certain that most of these methods are worse than useless, partly because they are very expensive and partly because they render the deposit or "sludge" valueless for manurial purposes or lead to no appreciably beneficial result. At the present moment lime, sulphate of alumina, and proto-sulphate of iron are the only substances which can be regarded as being fairly efficient precipitating agents in the purification of sewage. Lime chiefly induces precipitation by forming insoluble calcium carbonate with the free carbonic dioxide in the water. With the precipitation of this substance most of the suspended organic matter of the sewage is carried down and so forms the sludge or deposit at the bottom of the tank. It is well to recollect, however, that if too much lime is used, it dissolves a considerable quantity of the offensive matter previously in suspension and the effluent is thus rendered fouler and stronger than ever. *Sulphate of alumina* brings about precipitation by virtue of its formation, with the lime or calcium carbonate in the alkaline sewage, of calcium sulphate, the alkaline sewage being precipitated in the form of a flocculent material which carries down certain suspended organic matters. Sewage treated in this manner is less prone to induce decomposition and so in this important respect aluminium sulphate is superior to lime as a precipitating agent. The drawback, however, to sulphate of alumina is that the effluent is acid and harmful to vegetation and so cannot be used as an irrigation fluid. This objection is somewhat modified by the admixture of lime with the alumina in the proportion approximately of about five grains of each to the gallon of sewage as in this way a neutral sludge is obtained. Nowadays *iron protosulphate* is but little used as a precipitating agent. It has the insuperable objection of staining the mud banks of the stream into which the effluent is discharged a dirty brown colour, due, of course, to the formation of sulphide of iron and this in the eyes of the uninitiated public renders its use impracticable. However, the combination of iron with sulphate of alumina enters into the composition of several well-known precipitating agents—notably the ferrozone and the alumino-ferric processes. Occasionally substances which act as deodorizers or antiseptics are added to sewage in addition to chemical precipitation; for example, the addition of manganate of soda and sulphuric acid to chemically treated sewage was the original method devised by Dibdin, the chemist to the late Metropolitan Board of Works.

APPENDIX XIX. (*b*).

ON THE DISPOSAL OF SLOP WATERS.

Definition.—Slop waters consist for the most part of kitchen sink wastes, highly charged with foul decomposing organic matters, and house slops or urine, soapsuds, grease and dirt, together with rain and surface drainage.

Methods of disposal.

1. They may be *stored up in impermeable cement cesspools* and used for garden purposes by means of pump, hose, and jet. This method should not be employed in places where economy in water is not necessary, as the storage of foul waters in any form cannot be recommended.
2. They may be passed through a *small coke or ash filter* erected some distance from the house. The disadvantages of these filters are the constant attention they require, the ease with which they become choked up and rendered temporarily ineffectual, and the nuisance which may arise from them.
3. They may be disposed of by *sub-irrigation.* This, from a practical point of view, is the best and most efficient method. The drain conveying the slop waters from the house is connected by a few lengths of impermeable piping to a system of two-inch agricultural porous pipes, laid five feet apart, about twelve inches deep in the soil, and having a fall of from six to eight inches per hundred feet. The ends of the pipes rest on cradles formed of half pipes, and similar covers should be placed above so as to effectually prevent earth getting into the pipes and choking them. There must be an air vent at the lower end of the main outlet pipe to allow air to escape. A flush tank, discharging at intervals, should be fitted to the top of the system to prevent earth getting into the pipes and forming a deposit. The system advocated by Kenwood is the best. No mechanical cleaning of the pipes is necessary, as a syphon tank flush, discharging water at definite intervals from the head of the system, effectually provides a mechanical cleansing of the pipes. This system requires a spare field, preferably on an incline, and, once the pipes have been properly laid and fitted, gives but little trouble.

APPENDIX XX.

ON THE REQUIREMENTS FOR METEOROLOGICAL RESEARCH.

Standard instruments fitted in a proper Stephenson's screen should be provided. In order to obtain accurate reading this screen should be placed at a distance from all walls and trees and at least four feet above the ground. Inside the screen should be fitted a maximum mercurial thermometer, a minimum spirit thermometer, a dry and wet bulb thermometer, a registering thermograph (Richard Frères), and a registering barograph. A solar radiator thermometer should be placed on the roof of the screen, in a position freely exposed to sun and air, its bulb being directed towards the S.E.

An accurate Negretti and Zambra's Universal Sunshine Recorder, which possesses adjustments for any latitude, should be placed in an adjoining situation, care being taken that it is exposed to the rays of the sun in all directions. A minimum and terrestrial radiator thermometer should be placed on the grass close to the screen and the grass in the vicinity kept closely cut. Further, a registering rain gauge which records the amount and time of rainfall on a revolving drum should be placed somewhere in the neighbourhood of the house, but in such a position that it is not sheltered in any direction.

A Robinson's recording anemometer, which registers the velocity of the wind by means of a long shaft in the quarters of the medical men below, should be placed on the top of the administration block, preferably in as elevated and unprotected a position as possible. A Forten's standard barometer should also be fitted in the same position.

All observations should be taken and entered on a book specially printed for the purpose at definite hours, 8 A.M. and 6 P.M. being usually considered sufficient.

ESSAY FOR

THE ERECTION OF A SANATORIUM IN ENGLAND FOR THE TREATMENT OF TUBERCULOSIS.

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With whom are associated as Architects MESSRS. LAW AND ALLEN *(London).*

WE have the honour to present to His Majesty's Advisory Committee an essay and plans for the erection of a sanatorium in England for the treatment of tuberculosis. The principles of the treatment are so well known to the members of the committee that we deem it unnecessary to enter at length into theoretical considerations. The main problem practically resolves itself into the preparation of architectural designs to meet medical requirements. A few preliminary observations are necessary, however, to indicate the basis upon which we have formed our plans.

The objects of the treatment of tuberculosis on sanatorium lines may be briefly summarised as follows:—

1. To stay the activity of the disease by increasing the resistance of the patient.
2. To promote and to encourage reparative processes.
3. To develop compensatory growth and function of the sound portion of the lungs and to maintain heart power.

In order to accomplish these objects successfully great attention to detail has to be observed and experience has shown that the best results have been obtained when patients have been living under the constant personal observation of the physician.

When circumstances permit the required course of life may be carried on in the patient's own home; but for the vast majority of patients such a proceeding is impossible and the erection of sanatoriums has been attended with very successful results.

These institutions serve two purposes—curative and educational. Patients who have entered a sanatorium when the disease is in an early stage have not only derived great benefit whilst in the institution, but have been carefully instructed in the manner of life they should adopt on their return to their own homes. Unfortunately, amongst the poorer class of patients, and even amongst the more wealthy, who reside in towns, the necessary amount of fresh air is difficult to obtain, both in the dwelling-house and in the office or workshop, consequently it is desirable that a patient should remain in the sanatorium for a minimum time of from four to six months in order to advance the cure as far as possible.

A sanatorium for carrying out the requirements necessitated by the above considerations has to fulfil certain conditions, the chief of which are:—

A life spent in the open air; an abundant and varied dietary, in which vegetables occupy an important place; complete freedom from excitement of all kinds; rest during periods of the disease attended by fever; graduated exercise when the pyrexia has subsided; various hydro-therapeutic measures; constant medical supervision; and finally, life in the sanatorium rendered sufficiently varied and attractive (without detriment to the medical details) as to induce the patients to remain the required length of time under treatment. In our experience the last-named condition has been *greatly overlooked* both in English and foreign sanatoriums, with the result that patients find the life so dreary and monotonous that they leave after a residence of only two or three months. In the designs which we now present it has been our aim to attempt to fulfil all the requirements which have been mentioned above, especially to render the time spent in the sanatorium as comfortable and cheerful as possible without interfering with the out-door life. We believe that the medical officers of all sanatoriums will do well to bear in mind the words:—

> "Sweet recreation barr'd, what doth ensue
> But moody and dull melancholy?"

It is of course essential that patients should be prevented in every way from brooding over their condition and from discussing their progress with other patients, and that by every possible means their thoughts should be turned away from themselves.

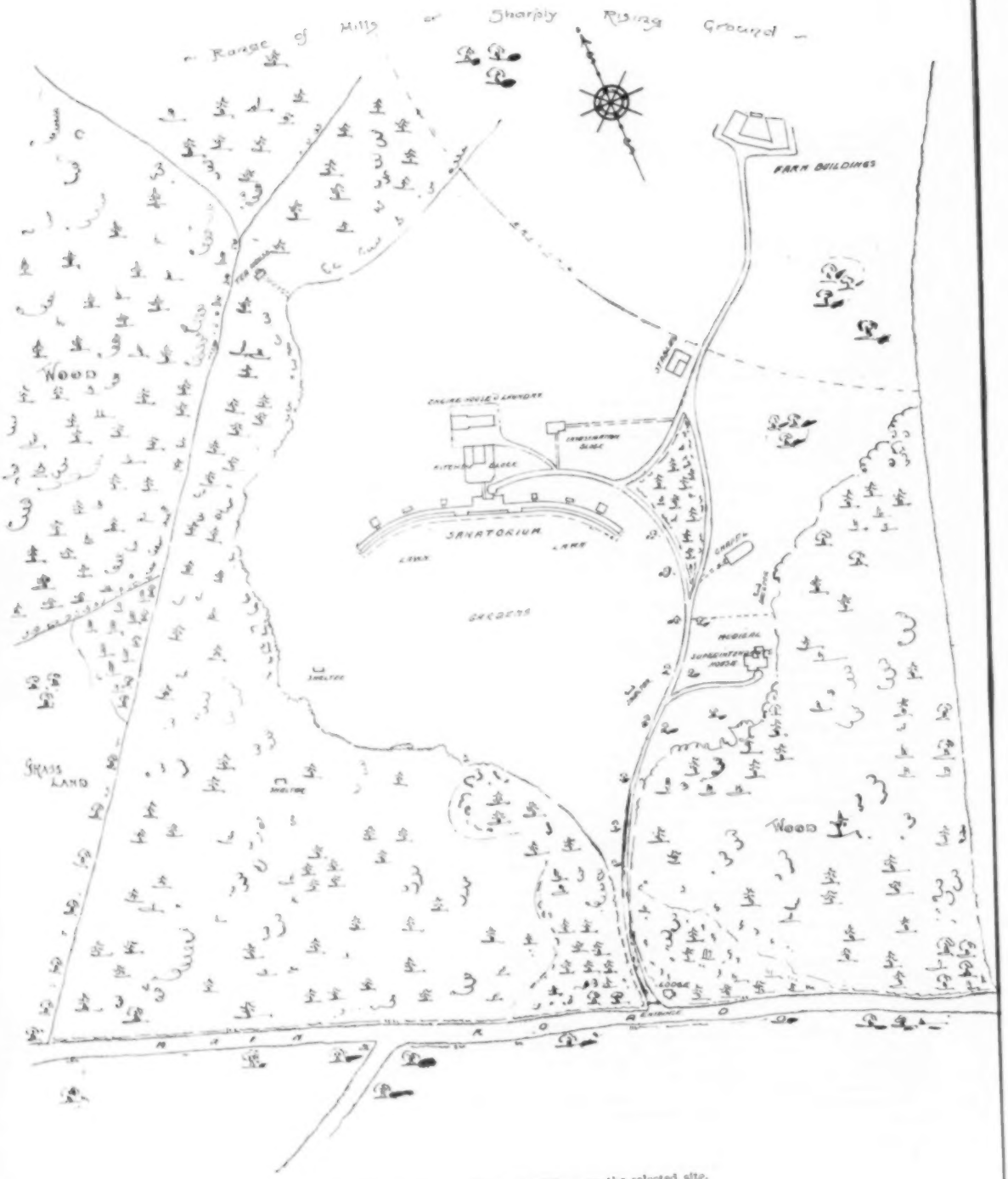
Certain recreations—namely, those that necessitate too violent exercise, or those that can only be carried on in a closed room—cannot of course be indulged in, but there are many that might well be introduced into the patients' lives, and in our plans we have made special arrangements for such.

SITE.

Before proceeding to describe our plans a few words may be said as regards the situation of the sanatorium (see Fig. 1). It is understood that it will be erected on an elevated and sloping site, with a sunny exposure, and well sheltered from cold winds, and that the soil will be dry and permeable.

Experience has proved that the near neighbourhood of the sea is not necessarily the best for pulmonary tuberculosis; further, it is not desirable that the building should be too near a town. Visits of friends and relatives should not be encouraged and, consequently, the site being some distance from a railway station is by no means a drawback. A large extent of grass land round the sanatorium is an advantage in preventing dust from rising and it would also be useful for

FIG. 1.



Suggested position of proposed buildings on the selected site.

the laying out of croquet and other lawns for the purposes of recreation.

If the country in which the institution is to be erected is thickly wooded it is highly desirable that the sanatorium be built in such a situation as to overlook the trees, otherwise the view from the windows and verandahs is greatly curtailed and is rendered dull and monotonous, whereas it should be as extensive and bright as possible; further, if the building is on a level with the trees the amount of direct sunshine is necessarily appreciably shortened, especially during the winter months. It would be undesirable, however, to place the sanatorium on the top of a hill, as the shelter from cold winds would then be lost.

With regard to the nature of the soil, gravel, sand, or limestone would be preferable, but of course a clay subsoil must be avoided.

THE BUILDING.

The form which the building should take has necessarily engaged our most serious attention. The choice lies between detached blocks (or cottages) and some form of the single block system.

The cottage system is attractive and for a comparatively small number of patients answers admirably; but we consider it very doubtful whether it would be so successful when a hundred patients have to be provided for. The cost of erection would be greater and the difficulties of supervision increased. The supply of food also to those patients who have of necessity to remain in bed all day would form another great objection to this system. Further, in some sanatoriums built on these lines, after a brief trial it has been found necessary to connect the separate blocks by covered ways, so that finally the building is converted into a formation practically similar to that which we now propose, and for these reasons we recommend the erection of a two-storied building. It is essential that all the patients' rooms should face south, and consequently a long frontage is necessary. We also lay stress on the importance of the dining-rooms likewise possessing a south aspect. The appetites of patients suffering from tuberculosis are often capricious, and to overcome this symptom is difficult, especially in the earlier stages of the treatment. During the whole day the patients have the opportunity of being in all the sunlight obtainable, and to bring them for their meals into a room facing north, into which direct sunlight never enters (as we notice has been done in some of the sanatoriums which we have visited), cannot but be depressing and a distinct bar to the encouragement which is necessary to those patients who find difficulty in taking a requisite amount of food.

Placing the dining-rooms in the south position, however, adds still further to the length of the south aspect of the building, but we believe it to be highly necessary. To obviate such a long frontage two devices present themselves, one is to have the building in more than two stories and the other is to erect a cross or ✕-shaped building.

Our reasons for *not* adopting a building of three or more stories are: that (1) the site of the building being in the country it is not so necessary to limit the space which the building occupies as is the case when a town site has been selected; (2) the necessary medical supervision is less easily accomplished in such a building, and greater difficulty is experienced when food has to be carried to the patients' rooms, the extra staircases and constant use of lifts causing delay; (3) the rooms are less accessible for the patients (this is of importance in the earlier stages of the treatment); (4) extra sanitary conveniences and emergency staircases would have to be provided, and the difficulties of heating would be increased; and (5) the large frontage affords more verandah space on the ground floor.

A ✕-shaped building offers still greater—and in our opinion insuperable—objections. The view from the back wings would be very limited, the major part being taken up by the rear of the front wings, and in many sanatoriums built on this principle lavatory annexes and other offices. Even if this objection is partially overcome by increasing the angle at which the wings are placed the necessary south aspect would be in a great measure lost. The rooms would then face south-west or south-east, with the result that the former would not receive any direct sunshine until the afternoon, whilst the latter would lose the direct sunshine early in the day. During most of the year this would prove a most serious drawback. It is the above considerations that have induced us to arrange our building on the two-storey plan, with a long south frontage.

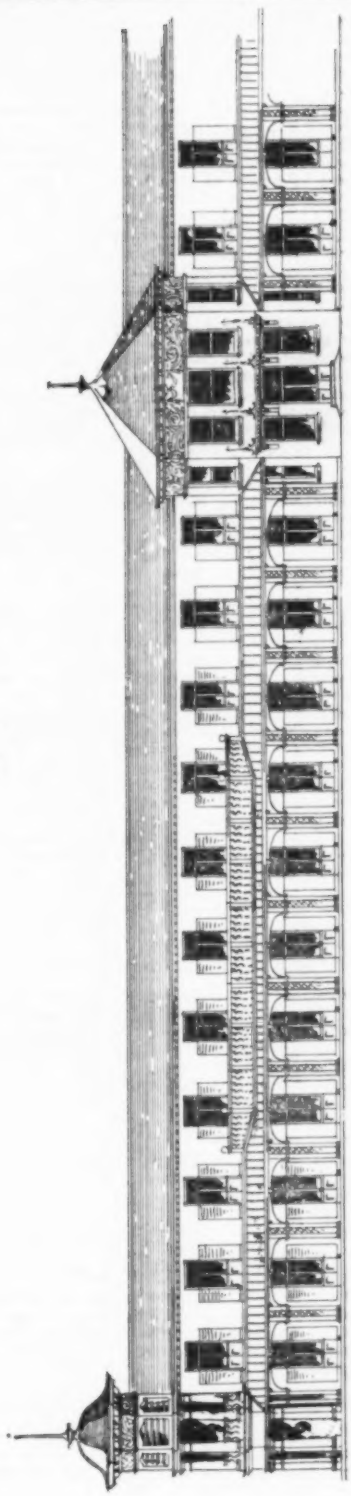


FIG. 2.

South elevation: western portion of façade.

We now proceed to give a general and also a detailed description of the building we suggest. Our general plans have, in accordance with the wishes of the committee, been worked out on a scale of 32 feet to an inch, but to explain some of the details we have appended sketches to a larger scale.

In designing the general appearance of the sanatorium we have rendered it as pleasing to the eye as possible. We consider this of some importance. Buildings erected on the austere lines of barracks or workhouses would tend to exert a depressing influence, whilst a bright and varied exterior would have the opposite effect on the patients whilst sitting in or walking about the grounds or returning from the prescribed daily exercise. Further, we have designed a brick and stone or stone edifice according to the part of the country in which the site may be selected rather than one made of wood. The last named is not so durable, and the interior of a wooden structure cannot be kept so clean or be so easily maintained at an agreeable temperature; this point has to be considered more especially in a sanatorium built in England. It has been suggested that wooden buildings, being so much cheaper, might for sanitary reasons be destroyed at the end of ten years and new ones erected. We do not consider this a sound view. As we shall explain, our rooms are easily cleaned, and in all such institutions the precautions taken in the disposal of the sputum reduce risk of infection to a minimum.

The plan we have adopted (see separate plans, Figs. 13 and 14) is a central building with two-storey segmental wings, arranged in the form of a curve so as to afford a certain amount of shelter without interfering with the south aspect, the total frontage of the building being about 700 feet. In front are placed deep verandahs. As the conditions specified by the committee require superior accommodation for "well-to-do" patients, the question naturally arose whether the rooms for these patients should be situated in the main building or whether a separate block should be erected. The latter plan would have necessitated a separate kitchen, increased domestic staff, additional heating apparatus, &c., at the same time making medical supervision more difficult. We therefore decided on the former plan and have placed the necessary apartments in the central block.

The sanitary annexes are placed at the back of the wings facing the entrances from the grounds, which are in the centre of the wings. The administrative block and kitchen offices are placed on the north side, centrally situated and connected directly to the main building by a corridor. The approach is from the north, whilst the laundry, engine-house, and investigation buildings are arranged on a suppositious plan, and have been placed within easy distance. Referring to the imaginary site plan (see Fig. 1) the location of the other buildings—namely, the entrance lodge, medical superintendent's house, chapel, stables and farm buildings—are approximately indicated.

The following is the accommodation provided:—

Patients of the more necessitous class in single bedrooms (male)	44
Patients of the more necessitous class in single bedrooms (female)	44
Well-to-do patients (male)	6
Well-to-do patients (female)	6
	100

Staff:—

Medical superintendent (private house) ...	1
Assistant medical officers	2
Matron	1
Nurses	6
Female servants, including those for kitchen and staff attendants	21
Porter and male attendants	5

We have calculated the requirements for the staff from the experience gained in a large number of the existing sanatoriums. The majority of the patients are able to get up during the day and consequently a large number of nurses is not required.

ENTRANCE AND ADMINISTRATIVE BLOCK.

GENERAL DESCRIPTION.

Ground floor.—The administrative block in which has been arranged the main entrance to the sanatorium has been provided with a porch which will obviate discomfort to the patients and others on arrival in wet weather.

On passing through the porch a hall is entered which will be fitted with a fireplace and will be made to look as attractive as possible. On the left of the hall is the secretary's office and general waiting room, and on the right is the main staircase to first floor and porter's office for inquiries and telephone exchange; this last arrangement being considered advisable as obviating the necessity of the porter leaving his office to attend to the telephone.

Consulting room and waiting rooms for male and female patients are placed leading off a corridor on the left side of the hall. On the right leading off the corridor to the kitchen and nurses' block is the dispensary and drug store together with a private dining room for use of the assistant medical officers.

Two staircases are provided for the use of the staff giving access to the first and second floors, and lifts for the use of the patients and for carrying luggage. All the staircases will be of teak and built on the latest hygienic plans, the sides not touching the walls, thus preventing the accumulation of dust, one plain handrail and newel and *no balusters*, but with a middle rail which will be found quite sufficient for purposes of construction and safety.

50 single bedrooms are placed on the ground floor (6 for well-to-do patients, and 44 for the more necessitous classes), and a wide corridor running at the back gives access to each room. As will be noticed on the plans, each of the room doors is situated exactly facing a window placed in the external wall of the corridor; this arrangement has been carefully considered and designed for the purpose of providing perfect through ventilation, and is a point to which the authors wish to call the special attention of the judging committee.

The six bedrooms, 12ft. by 12ft. by 10ft. 6in., arranged on the ground floor for the better class patients are situated facing a commanding terrace, and in the centre portion of the building. These rooms are more spacious than those provided for the more necessitous classes and the dining room is centrally situated. As it is intended that one side of the building be reserved for male and the other for female patients the separate dining-rooms for either sex of the more necessitous classes are provided at the inner end of each wing.

Serving rooms (see Fig. 5, page 50) are shown adjoining the dining rooms, in direct communication with the kitchens, and will be fitted up with all modern appliances.

A verandah (see Fig. 3, page 47) is provided in front of all patients' bedrooms on the ground floor, and runs the entire length of the building. A larger verandah has been placed in front of the better class patients' rooms and extended to form a stone framed terrace, finished with a stone balustrading and steps leading down to the gravel paths.

General lavatories (see Fig. 4, page 49) are placed in the annexes opposite to the entrances from the grounds, but separate annexes are provided for the well-to-do patients leading off the main corridors and are fitted up with the most modern sanitary fittings.

The corridors throughout (see Fig. 4) are five feet wide and well lit and ventilated by means of French casement windows which will open three feet six inches from the floor line in order to prevent the possibility of draughts.

Separate entrances from the grounds and cloak rooms (see ground floor plan, Fig. 13) are provided for the well-to-do patients in direct communication with their respective apartments.

Nurses' night-room and kitchens, housemaids' closets and water-closets (see Fig. 6, page 50) are provided in a separate annexe leading directly off the corridors.

Entrances and cloak-rooms (see Fig. 4, page 49) are provided in the centre of each wing and are opposite the lavatory annexes. The entrances have been placed in these positions so as to afford easy access to all rooms and similarly the annexes have been placed in the positions which we have described so as to save as much labour as possible to the domestic staff when performing their duties.

Extra staircases are provided at either extremity of the building which will form extra exits from the first floor in case of fire.

DETAILED DESCRIPTION OF SINGLE BEDROOM, CORRIDOR AND VERANDAH (SEE FIG. 3, PAGE 47).

It will be noticed that every patient's room in the sanatorium faces south and all are well ventilated.

Each single bedroom as arranged for the more necessitous classes is 12 ft. by 10 ft. 6 in. by 10 ft. 6 in. high, giving a cubic

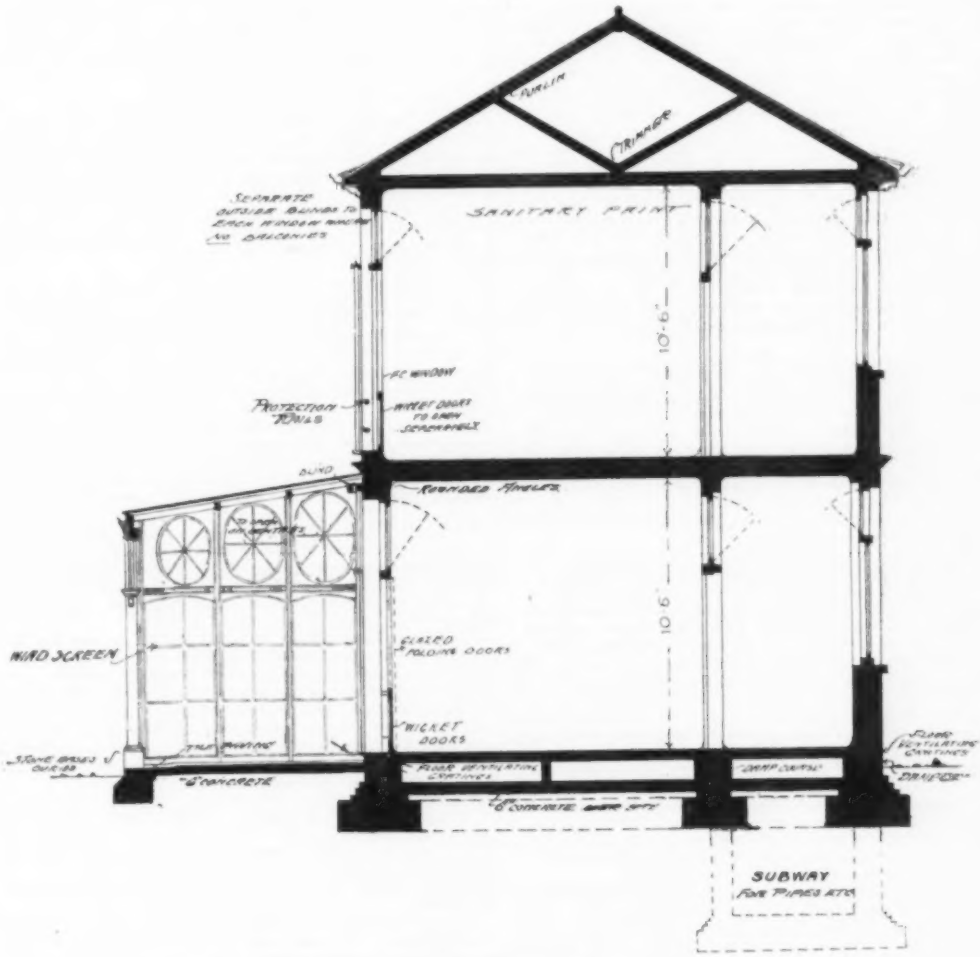
space of 1326 ft. and a superficial area of 126 ft. Under the method of ventilation adopted (that of constant open windows and fanlights) this space provides a larger amount of air than is absolutely necessary but is productive of greater comfort to the patient.

The windows, which open inwards, will be French casements, (so that the beds or couches can be wheeled on to the verandah if necessary), the lower portion of which is formed of wooden square panel folding doors about three feet high so that the patient's couch can be placed close to the window allowing only the head and shoulders of the patient to be seen; the middle panel is glazed with muffled glass in the lower rooms with a through ventilation the shafts are practically useless in the upper storey and entirely so in the lower ones.

The shafts add considerably to the expense of the building and easily become fouled; for the above reasons we have not adopted them.

Louvre shutters are shown to all the bedrooms (see Fig. 2, page 45) and will be used in times of driving rain or wind; and when closed against the windows free circulation of air can still be provided and at the same time rain is prevented from entering the bedrooms. These shutters are arranged to slide together so that they may be partially or wholly closed without occupying any room either on the verandahs or in

FIG. 3.



Detail of single rooms, corridor, and verandah in section. (Scale—one sixth of an inch to the foot.)

to obtain privacy when closed; the rest of the window and fanlight over it being glazed with clear glass, the latter being hung to open inwards.

The bedroom doors will be constructed of plain panels to avoid all dust and with glazed light over hung to open towards the corridor, each door being directly opposite each corridor window, so a direct through ventilation will be obtainable.

This method of ventilating will ensure an ample supply of fresh air and consequently no extraction shafts will be necessary. In those buildings fitted with extraction shafts, which have been subsequently adapted for the "open air" treatment, it has been found that where the windows are open the rooms. These shutters are preferable to the curtains, which are used in some sanatoriums. Draperies of all kinds should be avoided.

The floors will be of wood and covered with self-coloured linoleum, mouldings will be avoided and all corners rounded, the walls plastered with "Keens" or "Parian," and painted with a sanitary varnished paint. Strips of matting should be provided by the side of the bed and in front of the wash basin.

The furniture[1] used for the bedrooms which we have shown

[1] The figure showing the arrangement of the furniture has not been reproduced.

on our drawings will be light and free from unnecessary ornamentation. The dressing table and wardrobe will be of wood, the corners inside being rounded; they will be kept six inches off the floor, so that all cleaning can be easily managed. The top of the wardrobe will be made slanting to avoid accumulation of dust (which always collects on flat-topped ones), the chairs will be of bent wood, the bedsteads of plain iron, and pedestals of japanned iron with glass top.

Each bedroom will be fitted with a white earthenware lavatory basin with hot, cold, and waste fittings, all on the latest modern sanitary principles and placed on the inner wall. The hot and cold supply pipes will be cased in the wall and covered with felt or asbestos to avoid frost, the pipes being easily accessible if required by means of casings fixed with brass cups and screws.

It is not intended to have fireplaces in any of the patients' rooms, the same remark applying to the female and male staff bedrooms. It is generally felt that fireplaces in consumptives' rooms are not desirable. The dust and possibly smoke are conducive to internal irritation, and when not in use the flues are liable to down draughts. All the rooms will therefore be heated by hot water radiators placed, as suggested on the plan, at the foot of the bed; they will be of plain design and kept six inches off the floor and painted white

Corridors (see Fig. 5, page 50).—The corridors, which will be five feet wide throughout, will be well lighted and provided with French casement windows 3 feet 6 inches from floor line and all made to open. The floors will be of wood and covered with linoleum, the corners all rounded, and the walls plastered and painted with sanitary paint.

Two medicine cupboards will be fitted up in the main corridors on each floor, one in each wing, and provided with shelves and doors for containing the necessary bottles and urine glasses.

Subways (see Fig. 3, page 47) will be provided under the corridors for the various pipes and cables necessary for heating, steam and water-supply, lighting, &c. They will be reached at various points outside the corridors by means of small flights of stone steps inclosed with roof and sides and entrance under lock and key, the whole being under the control of the engineer.

The corridors will be heated by radiators as shown and can be easily regulated as required, each radiator being supplied with a regulating cold fresh air inlet ventilator at the foot of the radiator on the outside wall.

Verandahs (see Fig. 3, page 47).—The verandah will be of wood and constructed of ornamental posts and arches, and alternate spaces between posts filled in with lattice work for creeping plants, and the roof glazed with Rendell's patent wire glass glazing, distempered green, on under surface if necessary to minimise the heat rays, or, as we have shown, a large roller blind can be adopted for shading the sun on very hot days. The glass portion is protected from falls of snow from the main roof by means of guard rails. Portions of the verandah roof immediately over the bedroom windows below are arranged to open for the purpose of providing additional ventilation to the rooms beneath.

The floors will be of tiles bedded on concrete and laid to falls.

The verandahs will be heated by radiators between each window; this plan adds greatly to the comfort of the patients as at any time they can remove their couches close to the radiators and obtain warmth if the air feels chilly.

Wind screens will be provided where necessary.

In front of the verandahs we have suggested grass plots about 25 feet broad, protected by a low railing (see Fig. 13, separate plan). This has been done so as to afford as much privacy as possible to the bed-rooms. Patients of the opposite sex walking about the grounds will not be able to approach near enough to the rooms to be able to see the interior. This is naturally a matter of considerable importance.

We should further suggest that the medical officers should use a certain amount of selection in apportioning rooms to the patients. The cases which show pyrexia and consequently have to be kept in bed or lying down all day should be placed in the rooms on the first floor; whilst those patients whose temperatures are not raised and are consequently able to be up should be placed in the rooms on the ground floor. The arrangement of the glass in the windows has also been made with a view to this distribution of the patients. In the rooms on the first floor the French casements are of clear glass within three feet of the floor. This allows of the patient lying on a couch near the window so that only the head and shoulders can be seen. At the same time the patient's view of the grounds and surrounding country is not interrupted. In the rooms on the ground floor part of the glass is muffled so that when the patient desires privacy the windows can temporarily be closed and the interior entirely hidden from the outside. If the patient is able to be out of the room all day, however, the whole of the casement can remain open.

We suggest an inexpensive method of cooling the verandah roof during the occasional hot weather by means of a small spray pipe running round the front of the building at the first floor level and connected to the cold water services at various convenient points. This pipe will have a row of small holes which will throw jets of water to run down the glass roof of verandah into the gutters. This method has been found cheap and efficacious for keeping at a cool and even temperature not only brewery and other manufactory roofs and verandahs but also those of more than one sanatorium on the continent.

LAVATORY ANNEXES AND CLOAK-ROOM, &C.

Lavatory annexes (see Fig. 4, page 49).—The annexes which lead off the main corridors are detached except for a connexion on each floor by means of a lobby with windows on each side, thus affording an absolute aerial disconnexion from all parts of the building. The blocks are two storeys high and on each floor they comprise three bathrooms and one douche or spray-bath, three water-closets with lifting seats for use as urinals, lavatory accommodation and hairdressing-room combined.

The bathroom and lavatory, &c., will be built of glazed bricks with coloured dados, the floors of conglomerate mosaic, with proper wooden foot gratings where required. The sanitary fittings will be of the latest approved type, and all the best efficient methods will be used for quick discharging wastes and trappings, gulleys, &c.

The heating will be by means of hot-water pipes and radiators where considered necessary.

Cloak-rooms, boot-cleaning rooms, &c. (see Fig. 4, page 49).—It has been found that in most sanatoriums no provision is made whatever for the clothes and boots of the patients when they come in from the grounds or from their daily walks, so we have provided, as shown on the left of the entrance from grounds, a large cloak-room fitted up with hat and coat hooks, boot lockers, and all numbered to compare with the patients' numbers, and which will be heated with hot-water pipes for drying the clothes, &c., in wet weather. The boot-room on the left will be for cleaning the boots and store of any material the boot-cleaner may require; this room will also be heated with hot-water pipes.

Dining-rooms and servery.—The dining-rooms (see Fig. 5, page 50) as provided for the more necessitous classes are 35 feet by 18 feet 6 inches, lead off the main corridor, and have two doorways, one for use of the patients and the other for the attendants. The windows will be French casements and open down to the ground; every precaution will be taken to avoid dust, the floors being covered with linoleum and walls painted with sanitary paint. They will each be fitted up with tables to dine 44 patients.

A special servery is provided, with hot plates, sink cupboards, and carving-table, with a separate serving way into the dining-room.

Sun-blinds will be fixed to protect these rooms from the sun rays in hot weather.

Heating will be by means of fireplaces, open Teal grates being used.

During the warmer months of the year it would be found advantageous if the meals were served in the open air. We have therefore arranged gravel spaces in front of the dining-rooms; these could be protected by awnings. The necessary furniture could be taken from the dining-rooms and the food brought direct from the serving-rooms adjoining. The ground would be dry beneath the feet and the air would be fresher than in the rooms. This plan has been adopted in some sanatoriums with marked success.

NURSES' NIGHT-ROOM, KITCHEN, AND HOUSEMAIDS' CLOSET, &C.

This annexe which leads off the main corridor in each wing and on the ground and first floors (see Fig. 6, page 50) consists of nurses' sitting-room, small kitchen, and housemaids' closet, &c. It is suggested in a large institution of this kind that a nurse should be in constant attendance in case of

complications occurring at night and to look after patients in their bedrooms in the day-time.

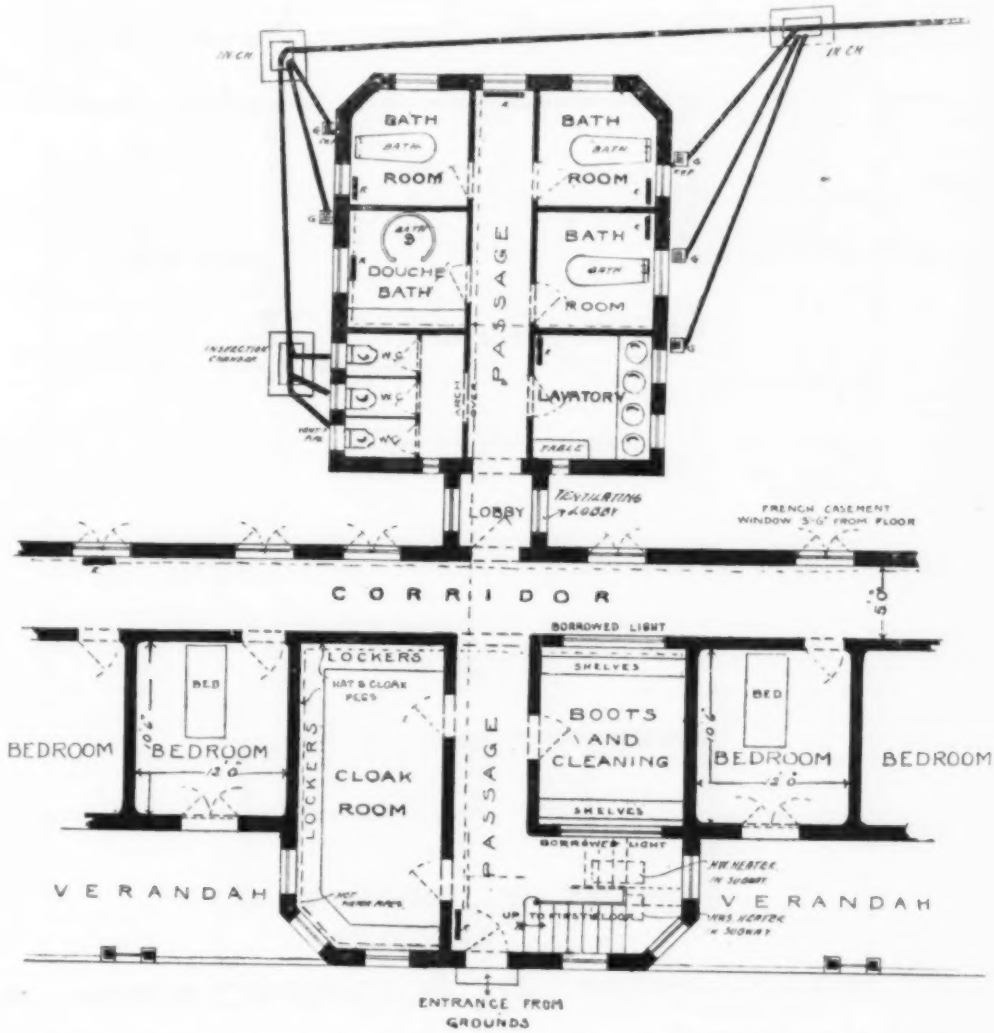
The nurses' room will be fitted up with bells and indicators from each of the bedrooms, the kitchen will have a small range for warming up milk, &c., sink, and usual cupboards.

Housemaids' closet will be fitted up with sinks and shelves and cupboard for the storage of cloths, &c. The water-closet will be found necessary for the housemaids' use in attending to the patients' bedroom pedestals.

potato steamers, grill, &c., and special apparatus for cooking any special class meals.

On the east side, and directly adjoining the kitchen, is a scullery, well lighted and ventilated, having communication with the kitchen and also with the kitchen yard. Proper sinks and washers are shown and all modern fittings will be used. Leading out of the scullery is the vegetable kitchen and vegetable preparing room fitted up with steam-jacketed sinks and washers.

FIG. 4.



Entrance from grounds: cloak-room and lavatory annexe for necessitous classes. (Scale—one-twelfth of an inch to the foot.)

KITCHEN DEPARTMENT, &c.

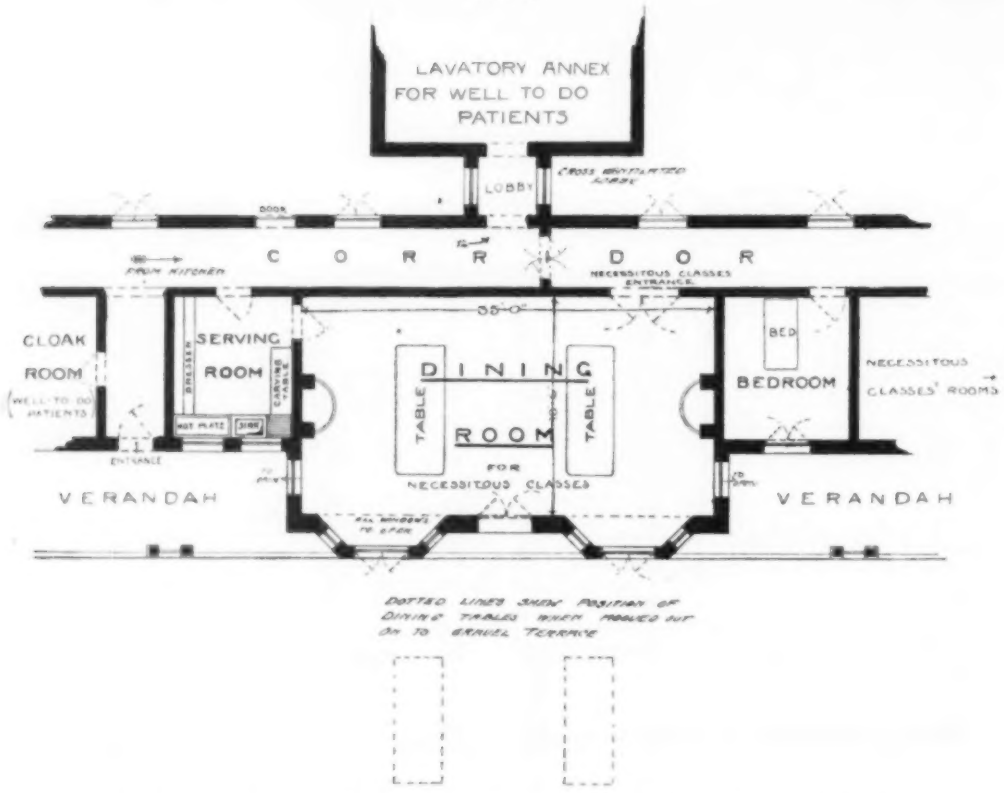
The whole of the kitchen department (see ground floor plan (separate) and Fig. 7, p. 51) is compact and centrally situated, and communicates with a corridor which leads off the main corridor, containing the dining-rooms, as shown on the drawings, so that food may be carried under cover all the way from the kitchen to the serving-rooms without passing through other departments. A large, well-lighted and ventilated kitchen faces north, with all windows to open for ventilation; it will be fitted with central cooking fittings and all modern kitchen appliances, entrée cookers,

North of the vegetable kitchen are the larders and dairy, fitted up with all proper slate shelves, &c., and the walls glazed with tiles.

On the west side of the kitchen are the stores and pantry, fitted up with sinks, &c., rooms for storing and cleaning cutlery and plate, and stores for glass and china are provided. Servants' hall, lavatory accommodation, &c., boot cleaning, coals, and extra emergency staircase from first floor are shown.

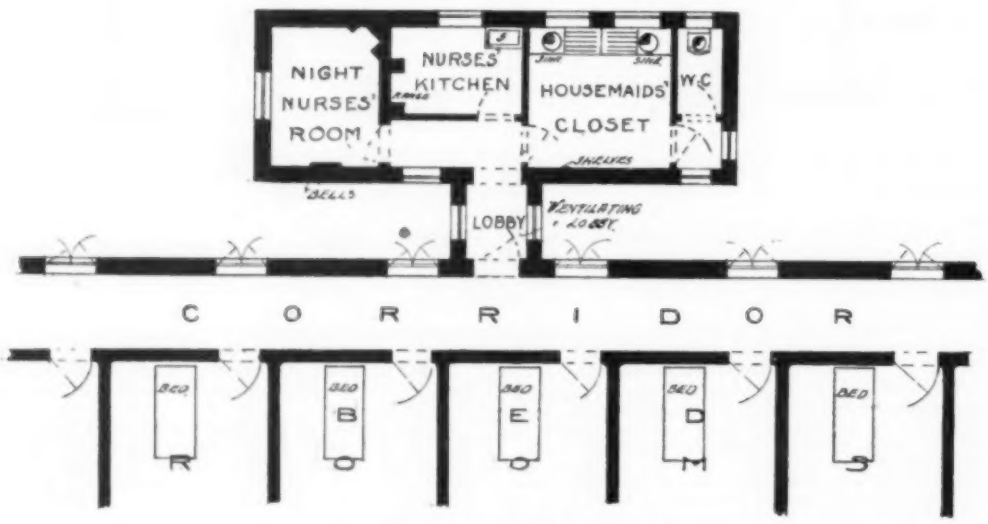
An airy and spacious kitchen yard is provided, around which all the various offices as described are arranged. In

FIG. 5.



Plan of dining-room and serving-room for necessitous classes. (Scale—one-twelfth of an inch to the foot.)

FIG. 6.



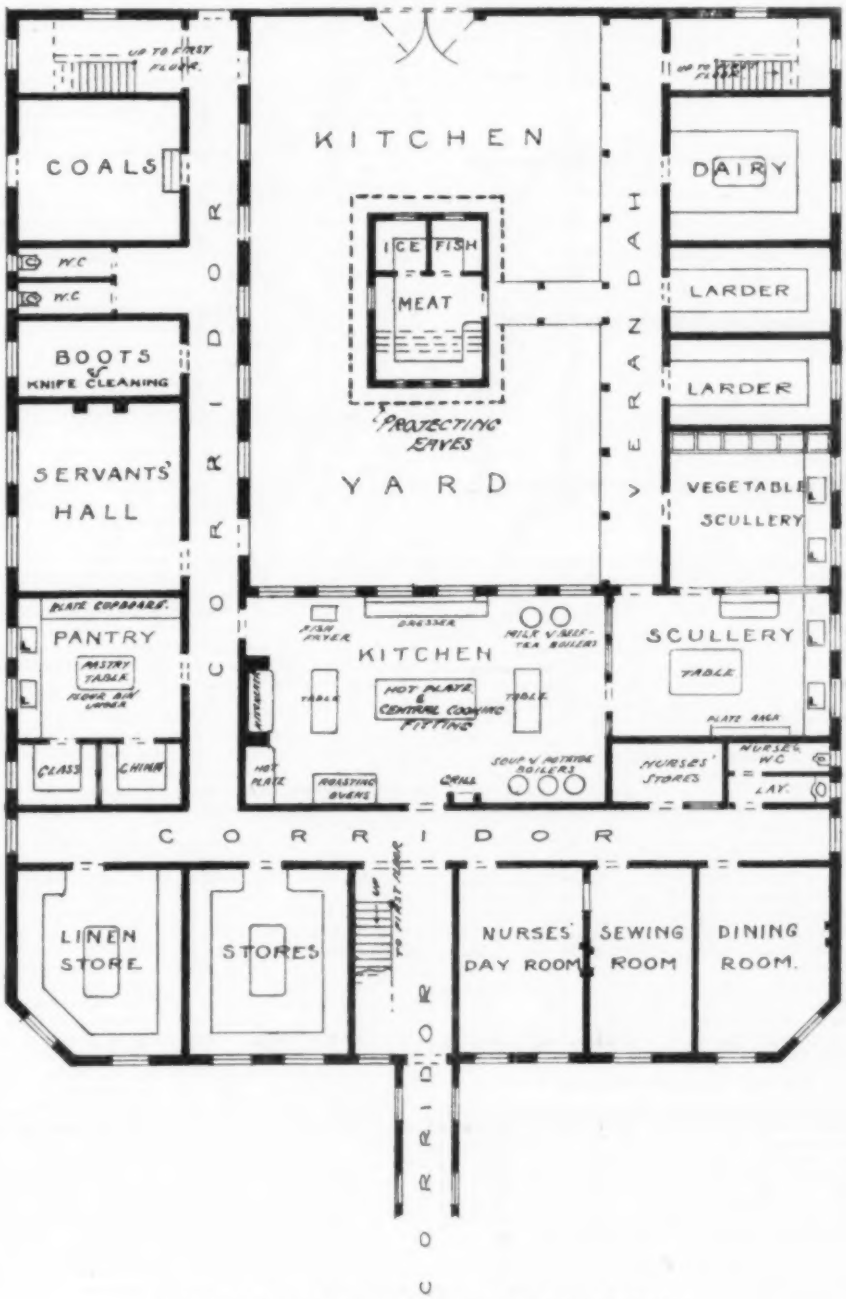
Plan of nurses' annexe. (Scale—one-twelfth of an inch to the foot.)

the centre, and leading off the covered verandah for protection from heat, are the stores for fish, ice, and fresh meat.

It will be noticed that complete communication is given to all the departments above enumerated by means of doors leading from one room to another or by a verandah, so the whole of the department can be comfortably carried on in bad weather. Another special point to which the authors would call attention is the facility given to the head *chef* for control, superintendance, and administration by means of the upper portion of all divisional partitions between the various offices, larders, &c., being glazed with clear glass.

Nurses' rooms.—Leading off the corridor communicating with the kitchen department is a teak staircase for use of the servants and nurses to first-floor bedrooms. Nurses' day- and

FIG. 7.



Plan of kitchen block. (Scale—one-sixteenth of an inch to the foot.)

dining-rooms are provided on the ground floor, together with a sewing-room. Large linen stores, fitted with all proper shelves and lavatory accommodation, are shown.

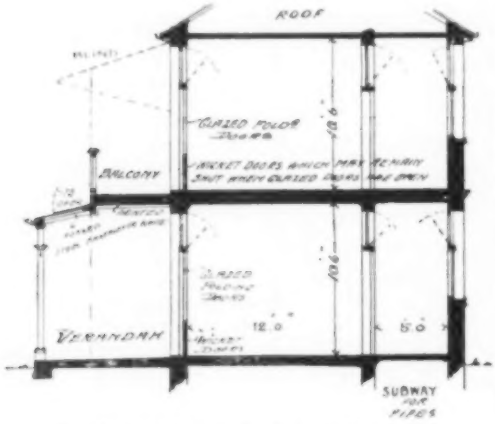
FIRST FLOOR.

On ascending the staircase from the ground-floor entrance-hall (see first floor plan, Fig. 14) (separate) the main corridors are approached by a gallery overhanging the main entrance-hall.

The corridors, single bedrooms, cloak-rooms, nurses' and lavatory annexes are similar to those described on the ground floor.

A large proportion of the single bedrooms, and those of the well-to-do patients' bedrooms, open on to a balcony above the ground-floor verandah (see Fig. 8), which has

FIG. 8.



Plan showing balcony to first-floor bed-rooms: section. (Scale—one-twelfth of an inch to the foot.)

been so designed as not to interfere with light for the ground floor bedrooms. A roller-blind is shown over the balconies which can be easily adjusted by the patient if required.

A special feature will be noticed with regard to windows on the first floor not having balconies. In order that these windows may be opened to their fullest extent—viz., from the floor-line upwards—we have arranged a simple iron railing of two one-inch guard-bars and standards, thus preventing any injury to the patients by their falling out or walking out on to the glass roof of verandah.

A library is shown for the reception of books for the patients but it is not intended for reading in. Staircases and lifts are provided communicating with each floor and ample store accommodation in each wing for matron's stores, this being found necessary for storing glass, linen, &c. Bed-, sitting-, and small dining-rooms, together with bath-room and lavatory accommodation, are provided for the matron. Two bedrooms and their complementary sitting-rooms with bath and lavatory accommodation are provided for the two assistant medical officers.

A *medical officers'* billiard-room is shown and also two spare bedrooms, in case they should be required.

Box-rooms are shown leading off the corridors.

Emergency staircases are provided at the end of each wing in case of fire.

FEMALE SERVANTS' QUARTERS.

Over the kitchen-block (see Fig. 14, separate plan) are the female servants' quarters, which are approached by a corridor leading from the main corridor. A staircase is also provided for their use from the ground floor kitchen block. Bedrooms are provided for 21 servants and six nurses, with a nurse's spare bedroom. Proper stores and housemaids' closets, bath-rooms, and lavatory accommodation are provided. Emergency staircases are shown at the end of each corridor.

SECOND FLOOR.

This floor (see Figs. 9 and 10) is mainly occupied by the *Recreation Hall*. This room forms a distinguishing feature of our plan and we are not aware that a similar idea has been made use of in any existing sanatorium. We have throughout maintained that it is of the utmost importance in order to favour the progress of the treatment that adequate means should be provided for the recreation of the patients. We shall later suggest the various forms of amusement that may be employed in the grounds, but more than this is necessary. Certain games which can only be played indoors, such as billiards and bagatelle, and also musical entertainments, have hitherto been entirely denied to the patients. We have therefore designed a large room with windows facing all quarters which can be, together or separately, opened according to meteorological conditions, thus obtaining a most airy apartment under any circumstances.

In addition to these arrangements, however, a *moveable roof* has been provided, so that at all times when rain is not actually falling the room practically becomes an open-air space in which patients can indulge in the above-named amusements without infringing upon the strict terms of life in the open air.

In order to economise space we propose that the billiard table should be placed at the north end of the room and that a moveable platform should be erected which could, by means of runners, cover over the table and so be used for concerts or other entertainments, which would then also take place practically in the open air. We have purposely arranged this room on the second floor so as to assure that the access to it is not too easy and that it is easily under the control of the medical officers. If the room had been built as an annexe in the grounds it would have formed a constant temptation to the patients to resort to it at all times and its form would have had to be considerably modified, rendering it an open-air pavilion. The erection of such a building in this position in other sanatoriums has not been altogether successful, it being found that patients took shelter within it whenever the weather was in the slightest degree inclement.

A balcony with French casement windows is placed on the outside over the library bay window. On this floor we have arranged for two bedrooms which are intended to serve as isolation rooms (see Fig. 9, page 53). Cases may arise in which it is desirable that the patients should be removed in order to secure greater quiet than can be obtained in the ordinary rooms or in case circumstances should occur which should render isolation imperative.

The hall will be heated by radiators and ventilation will be amply supplied by the open roof and windows.

Bedrooms on this floor are provided for the men servants, together with bath-room and lavatory accommodation.

Lifts and staircases are also shown.

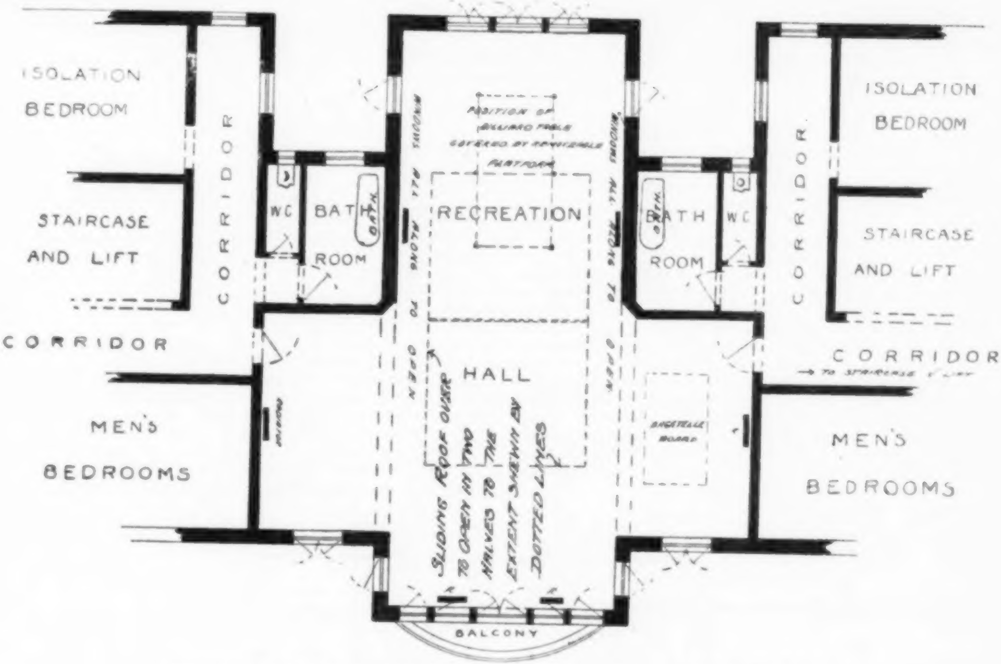
THE INVESTIGATION BLOCK.

The opportunities for the scientific investigation of certain aspects of tuberculosis will be exceptional in such an institution as it is proposed to establish, and we have deemed it advisable to place the laboratories in a separate block rather than in the main building (see Fig. 11, page 54) so that greater seclusion for the investigators may be secured and trouble from any objectionable fumes or risk of infection may be safely guarded against. We have also considered it most convenient to attach the post-mortem room and mortuary to this block so that the necessary examinations can be made without attracting undue notice.

A laboratory, both for bacteriological and pathological examinations, is of course a necessity. The methods of feeding adopted in the "open-air" treatment offer ample opportunities for studying metabolic changes, such as are indicated, for example, by chemical examinations of the urine and fæces. We have therefore arranged for a separate chemical laboratory, where such experiments would be carried out. We have also included a room where x ray or other electrical work might be carried on and a dark room for photographic work has also been supplied.

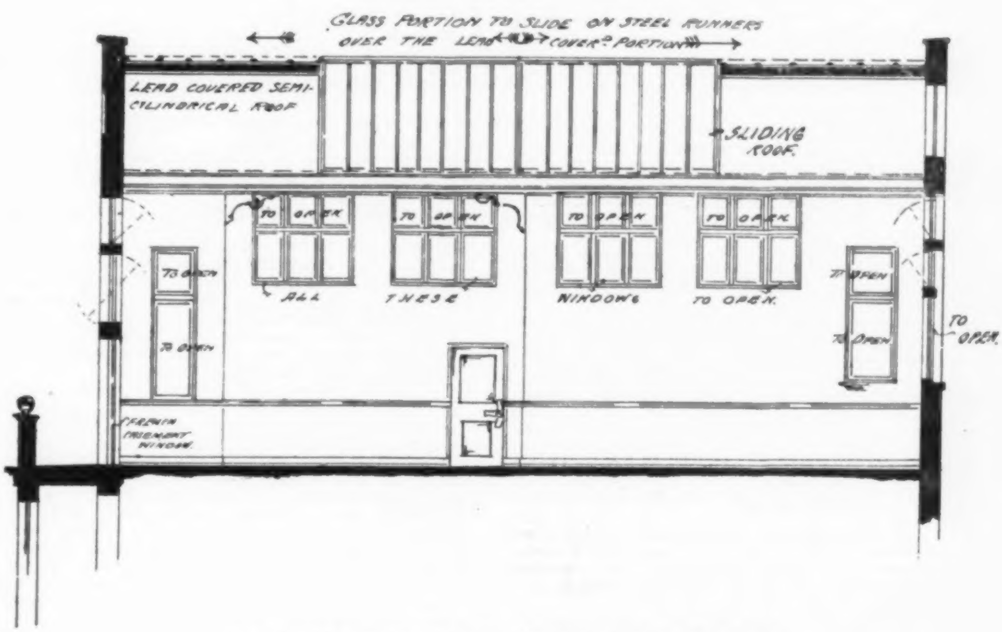
The main entrance is from the south. The chemical laboratory is on the left. It will be provided with the necessary fittings, shelves, benches, etc., and a cupboard with outlet for carrying off evaporations or for the preparation of noxious gases. Passing onwards, the bacteriological laboratory is entered, the size of which is 35 feet by 18 feet; this will also be fitted with the needful appliances and ample room has been provided for three workers. Adjoining the laboratory is the room for the preparation of the culture media; this being a separate apartment will add considerably to the comfort of the medical officers. The laboratory is lighted from above as well as from the north. The

FIG. 9.



Plan of second floor showing recreation hall. (Scale—one-twelfth of an inch to the foot.)

FIG. 10.



Section through recreation hall. (Scale—one-twelfth of an inc to the foot.)

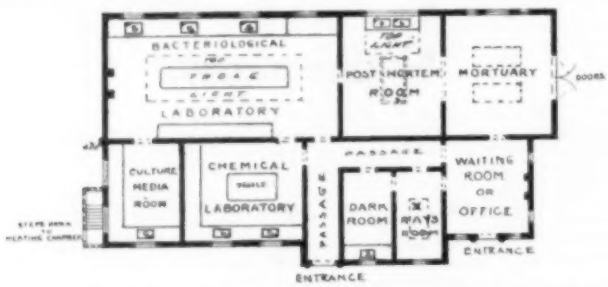
electrical room connected with the dark room is on the right. The waiting-room or office opens from the former, but has also a separate entrance from the outside for the use of patients entering the electrical room. The mortuary, to hold two bodies, is entered from the east. The post mortem room adjoins, and can be entered from the mortuary or from the laboratory, and will be fitted up with the necessary table with sink attachment. The walls of the laboratory and post-mortem room will be of white glazed bricks and the floor of mosaic, which can be easily cleaned by means of the hose. The necessary sinks and washing apparatus will be placed in the different rooms.

The heating will be by means of hot water pipes supplied by an independent apparatus placed in a heating chamber below the culture room and accessible by means of stone steps outside.

MEDICAL SUPERINTENDENT'S HOUSE.

It would be to the advantage of this institution for the post of medical superintendent to be a permanent one and we have therefore provided a separate house for this official. The accommodation provided on ground floor includes entrance hall, drawing and dining rooms, library, kitchen, servants' hall, and the usual domestic offices. On the first floor and in the attics are eight bedrooms, bath and box-rooms, and the usual lavatory accommodation. This building will be erected of the same materials as are selected for the sanatorium, and all sanitary work will be of the most modern type. A telephone exchange will be provided from the sanatorium to this house, so that the medical superintendent can be communicated with at any time.

FIG. 11.



Plan of investigation and mortuary blocks. (Scale—one twenty-fourth of an inch to the foot.)

ENTRANCE LODGE.

The lodge, which is placed at the entrance of the drive, will be the residence of one of the male attendants and fitted up with a telephone exchange to the sanatorium; it will consist of a living room, kitchen, bedrooms, and usual offices.

STABLES.

The stables have been placed on the north-east of the main building and in close proximity to the farm; a telephone exchange will be fitted up between the stables and the sanatorium.

The building will be composed of a four-stall stable, harness room, coachhouse for three carriages, men's rooms, &c., and rooms over the coachhouse for the coachman and his family, and all proper lavatory accommodation. Ample space is provided over the stable for fodder and straw stores. Special care has been given to the ventilation and all up-to-date fittings will be used. The stable walls will be glazed with tiles and the floor constructed of yellow Dutch clinker bricks. The drainage of the stable will be carried out on the latest improved sanitary plans.

CHAPEL.

We have submitted plans for a chapel which can be erected at the discretion of the committee; it does not, however, form a necessary part of the sanatorium, as the recreation room might be used for the purposes of Divine worship.

The plan of the chapel consists of an entrance porch, nave, chancel, and sanctuary, together with two vestries and organ-chamber. The accommodation provided is for 64 in the nave and 18 in the choir. The heating would be by means of hot-water pipes supplied by an independent apparatus placed in a heating chamber under the vestries, which would be accessible by means of stone steps outside.

BOILER AND ENGINE-HOUSE, LAUNDRY AND SPUTUM DESTROYER.

Boiler-house, &c. (see Fig. 12, page 55).—The selection and position of the site and its water supply will govern the best position for these buildings, but for our plans we have placed the engine house and laundry, &c., at the back of the kitchen block about 100 yards distance. (See Fig. 1, page 44.)

These buildings will be under the control of the engineer and it is always advisable if possible to have them in one block so as to be under his personal supervision.

The engine department comprises a boiler house top-lighted and designed to accommodate three Lancashire boilers, as it is proposed to do the whole of the heating, hot water service, laundry work, cooking, and lighting from this one central boiler house (two boilers for working and one for spare in case of breakdown). These boilers are all intended to be of the same capacity and work at the same pressure for the sake of economy and ease of management. We also provide space for condensed steam (boiler feed) tank and injector pump, and entrance to the subway.

The boilers are set at a lower level than the ground outside and are stoked from a coal cellar at the back of the boilers. A large coal cellar is shown and coals will be supplied from outside, there being the necessary shoots for so doing.

Engine and dynamo house (see Fig. 12, page 55).—This building is designed to contain three vertical engines and dynamos set on isolated foundations to avoid vibration. The house will be well lighted, and will be divided from the boiler house by a glazed partition.

The accumulator room adjoins and will be filled up with all proper stands for the glass cells. This room is to be top-ventilated for escape of fumes.

A small fitter's shop is shown which will be found useful for the engineer.

Lavatory accommodation will be provided.

The chimney flue from boilers will be taken up the side of the boiler house. The flue will be fitted with a fine spray pipe at the base, having a continuous water spray playing upon the smoke which will thus deposit the carbon and minimise the density of smoke. This method has in the experience of one of us proved far more effectual than many of the patent so-called smoke-consuming apparatus.

SPUTUM DESTROYER.

Each patient will be required to carry a pocket spittoon. These will be collected every evening and taken to the room adjoining the destroyer. They will then be emptied into iron receptacles and cleaned with an antiseptic, most conveniently a solution of carbolic acid, and thoroughly washed, next morning being returned to the patients. During the night ordinary spittoons will be used which will be collected in the morning and treated in a similar manner. The sputum will be mixed with sawdust and the iron receptacles already mentioned placed in the destructor and the sputum thus destroyed by heat. This forms by far the most satisfactory method of dealing with it.

The sputum destruction house (see Fig. 12, page 55) will be built of glazed bricks from top to bottom and be fitted up

with all proper sinks, drainage boards, and all fittings for the washing of the flasks, &c. Hot water will be laid on and all details will be on the latest modern principle. The destructor will be the latest modern fitting and will be enclosed in fire brick and built in as shown. Stoking can be done from outside. A small space has been provided for coke and storage of the receptacles.

LAUNDRY.

The laundry (see Fig. 12) has been arranged adjoining the engine-house, so that steam and electricity for driving the motors are close at hand.

A separate entrance to the disinfector is shown, and an outlet on the other side of the house has been provided so that the disinfected clothes may be taken straight into the wash-house, thence through the ironing and finishing rooms. A sewing-room adjoins the finishing-room and shelves will be fitted up for the store of clean linen.

The laundry will be furnished with the following fittings—viz., disinfecting apparatus, washing and rinsing machines, soap-boilers, glazed washing troughs, boiler tanks, ironers, and hydro-extractors.

WATER SUPPLY.

We understand from the committee's conditions that there will be an abundant supply of water; therefore we have not entered into any description of this subject.

In every single bedroom on the ground and first floors we propose to fix a hot-water heated radiator at the foot of the bed, as shown, and they will also be provided in a convenient place in all the servants' bedrooms. Radiators will also be supplied on the verandahs, as before described.

The corridors, bathrooms, and lavatories on the ground and first floors will be heated by hot-water radiators, placed next to the outside walls where possible, in order to introduce *fresh* air properly warmed into the apartments instead of heating the air already in the building.

The cloak and boot-rooms will be heated by hot-water warming-pipes under the lockers, as shown.

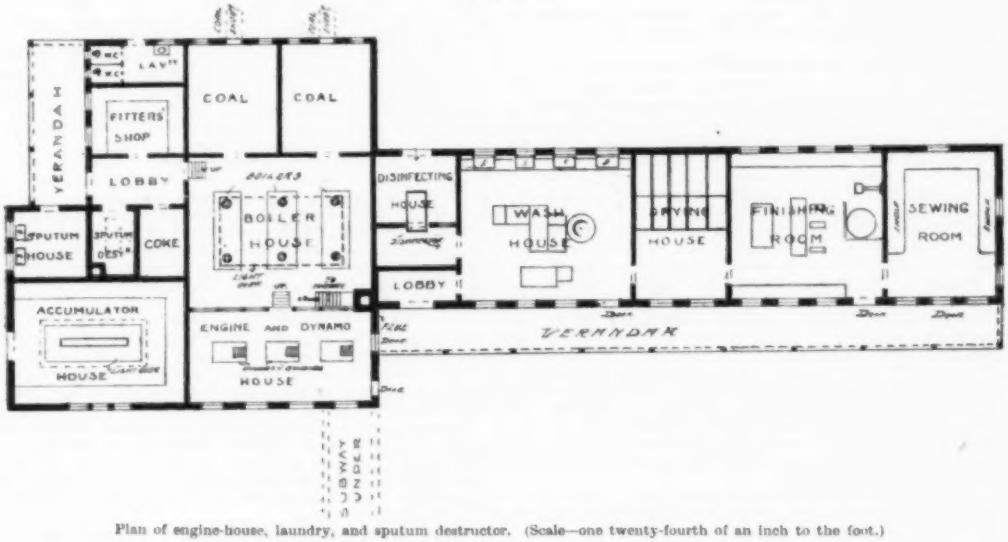
The hot-water supply to the baths and lavatories and housemaid's sink (see Fig. 4, page 49) will be done by means of calorifiers placed alongside the hot-water heater as shown, and heated by steam from the steam boilers.

From the steam boilers we take the main steam-pipes in a subway under the corridor as shown to these heaters, and from the heaters take back the condensed waste water for re-use in the steam-boilers.

From the hot-water warming heaters we take the main circulating pipes, as shown, with branches to serve the several radiators where shown in their different positions.

From the hot-water supply heaters we take the main circulating pipes and branches as shown, to all baths, lavatory,

FIG. 12.



Plan of engine-house, laundry, and sputum destructor. (Scale—one twenty-fourth of an inch to the foot.)

HEATING AND HOT-WATER SUPPLY.

General description.—It is of distinct importance that warm water should be available all night. The mode of heating, which we briefly describe below, will enable hot water to be drawn off at night from any of the taps, and the whole system will be regulated and kept in constant good order.

The warming will be carried out on the low-pressure hot-water system, and for this purposes we have used Berriman's hot-water heaters. By this method we do away with the objectionable heating by steam radiators direct, which of necessity can only remain at one temperature and are liable to burn the air instead of properly heating the same, and also with the difficulty, waste, and expense of heating by hot water laid direct from the boiler house. By the method we have adopted these heaters are placed in the sanatorium proper, situated at various points in the subways below the corridors, and are heated by means of steam pipes direct from the boiler house, and the hot water necessary to supply the radiators and other services and fittings is thus drawn direct from the heaters. The radiators will have flow and return valves in order that the degree of heat may be regulated as required.

basins, housemaid's sinks, and other fittings requiring hot-water.

ELECTRIC LIGHTING.

Lighting will be by means of electricity and the wiring will be on the three wire system. Current will be supplied from the two combined 260 horse-power vertical engines and dynamos, an extra engine being provided in case of breakdown.

Although there are objections to the use of the accumulators yet there is on the whole a distinct gain in their use; a minimum night staff is required, and in summer the engines have to be run for only a short period of the day.

In the corridors arrangements will be made to reduce the lights during the night.

Lights will be placed in suitable positions on the bedrooms and on the verandah, shelters, &c.

Switches will control lights in sections.

DRAINAGE.

This subject being a most important point of the construction of the sanatorium it will be found impossible to describe the form of drainage to adopt till we know for certain the position and levels of the site to be selected. The methods of sewage disposal are many and adoption of either course would

be determined when the site is chosen. As there will be possibly no public sewers, it would of course be necessary to carry the soil in stone glazed pipes to cesspools formed on the lower portion of the estate. Filter tanks would be formed and the effluent will be turned on to the land, which should have, we should suggest, a subsoil of sand.

The drainage from all the buildings would be on the latest modern principles—glazed pipes laid on concrete all to falls, inspection chambers, traps, and ventilating pipes, and all to make it a first-class sanitary drainage scheme.

TEA HOUSE.

The position of this building, which will be described under the heading of "Grounds and Recreation," has been designed in the form of an open verandah, closed in at the back and fitted with windows, the sides having moveable wind screens, the front being entirely open.

The back part will consist of a small kitchen, &c., for making tea and store accommodation for utensils, cloths, &c.

The design will be as ornamental as possible to give a pleasing appearance for the patients and form an attractive building among the trees.

SHELTERS.

These shelters will also be described under the heading of grounds and will be constructed of wood and kept seven inches off the ground; they will be in the form of a covered wood verandah, having windows to open all round.

Seats will be provided as shown.

Revolving shelters are also arranged, overlooking the croquet lawns and assistant medical officers' tennis lawn.

THE GROUNDS FOR RECREATION AND EXERCISE.

The arrangement of the grounds (see Fig. 1, page 44) in a sanatorium for tuberculosis is of the utmost importance, forming as it does an essential part of the treatment. In order to develop the compensatory growth and promotion of the sound portion of the lungs and to maintain heart power, exercise is necessary; the amount and nature of the exercise is prescribed daily by the medical officers. Walking is the form generally adopted, first on level ground, subsequently on slopes, the gradient being gradually increased. It is consequently desirable that the grounds should not be all level. Seats should be placed at known and convenient distances.

Without a plan of the exact site on which the sanatorium is to be erected, it is, of course, only possible to speak in general terms of the various devices which may have to be resorted to in order to render the grounds as suitable as possible for the carrying out of the treatment. If the neighbourhood is thickly wooded, enough shelter may exist naturally, but in all probability wind screens would have to be built to afford protection from the prevalent strong and cold winds, so that patients could take exercise in spite of the wind, for experience has amply proved that tuberculous patients suffer more inconvenience from wind than from any other atmospheric condition.

As we have shown the verandah faces south; when, therefore, a strong south wind is blowing with driving rain, it may be hardly possible for patients to remain on the verandah. It is not desirable that the patients should seek protection indoors under these circumstances. Shelters should, therefore, be placed in the grounds so that patients may use them when necessary. These shelters should face different ways so as to afford cover from any wind that may be blowing. Some of them should be near the main building so that writing materials, tables for chess, draughts, cards, &c., may be easily carried to them; in fact, every device possible should be made use of to render them attractive to the patients. We advise these shelters instead of reading and writing rooms for the patients. The full access of air to them is considerably greater then in any ordinary room, although the windows in the latter may be kept widely open.

Another point in the arrangement of the grounds is that as much opportunity as possible should be given for the recreation of the patients. We consider that most of the existing sanatoriums are greatly lacking in this respect. It is undoubtedly essential that rest should be enjoyed during the time that a patient's temperature is raised, but when there is no pyrexia the indulgence in games which do not call for undue muscular effort are of great advantage. Croquet is a game which is particularly suitable for tuberculous subjects. Played under the modern rules it affords interest and amusement for hours; it induces patients to remain for a long time in the open air, taking an amount and kind of exercise which can only be beneficial. Handicapping is simple, so that all grades of players can take part in tournaments with hopes of success. We should therefore suggest that at least six croquet lawns should be provided.

Lawn tennis is not of course suitable for patients, although a court might be provided for the use of the medical officers. We might suggest, however, that table tennis requires far less exertion and tables might be placed in the grounds for those patients who have nearly completed their course of treatment, the effect on the temperature being watched by the medical officers. If this game were found suitable it would certainly act as an encouragement to those patients not so far advanced towards cure to continue in the sanatorium until they also could venture on more active exercise.

Two courses might also be laid out for the "putting" game of golf. Whether further liberty might subsequently be permitted by allowing a more extended game (the club not being raised above the shoulder) is also a matter which we think might well be considered. If there should be level roads within easy reach of the sanatorium we see no reason why bicycling should not be allowed, fast riding or hill-riding being, of course, sternly prohibited. From experience we have found that patients who have advanced far enough towards recovery to be permitted to take more active exercise may be thoroughly trusted, as a rule, not to take any undue advantage of these concessions.

A bowling-green might also be provided. We think it doubtful whether archery might be introduced, as the strain across the chest might be too excessive. Quoits and similar games would, however, be suitable. Shooting with an air-gun is another relaxation which might be introduced.

We feel sure that if sports of the above nature were freely encouraged the life in the sanatorium would be rendered much more pleasant and the patients could be more easily induced to remain the required length of time than is at present the case. We have already referred to this subject when describing the recreation room.

At one extremity of the ground we suggest the erection of a tea-house which patients might visit in the afternoon; it would give an object to those patients who are not able to walk far and are not thought well enough to play croquet, &c.

Wooden seats should also be placed at varying distances throughout the country surrounding the sanatorium. These act as guides to the patients in their daily walks both as regards distance and direction.

FARM BUILDINGS.

As milk forms a large proportion of the dietary for tuberculous patients, the importance of its purity can hardly be over estimated, and as pigs and poultry form an economical means of disposing of waste from the kitchen we have carefully planned a farm based on those lines.

The cowsheds have been designed with special reference to the prevention of tuberculosis in cattle, and beyond the fact that we allow greater air space per head of stock and provide considerable cross ventilation there is no increase of expenditure over the more ordinary type of farm buildings that are generally found.

The position of the farm buildings will depend upon the formation of the site selected, on a position, say, of 1000 yards or more away from the main boiler-house steam can easily be obtained at 30 pounds, thus supplying the most economical means of heating the food, preparing coppers, &c., and a large quantity of water for cleaning the dairy utensils.

On the west are the cow byres; to the east are the piggeries; in the centre is a large open grass plot, forming a convenient place for temporary chicken-runs; at the back of the grass plot are mess-rooms for the farm hands. Tool and implement stores are at the back; extending away from the farm buildings is the poultry farm.

Provision is also made for lime for fowls; coal, wood, and coke for stokeries, and general lavatory accommodation for farm hands.

In front is the entrance to the farm, on one side is the dairy and bailiff's cottage, and on the other side is the stable for farm use.

The dairy.—It is entered from the central yard and is in a convenient position for receiving and delivering milk. It comprises:

1. A milk store, fitted with slate shelves for separation of cream on a small scale. The roof is lined with slag wool for the sake of coolness and has a louvred lantern; louvres are also placed in the door. The slate-covered verandah shades

the windows on the south from direct sunlight while allowing plenty of light. All openings will be covered by fine gauze to keep out dust and flies. The floor is concrete faced with cement and roughened with fine granite rolled in. It slopes to an open channel leading outside to trapped gullies close to the entrance of the steam pipe (supplying heat to the scullery), for the prevention of freezing during frost. The internal walls are lined with white glazed tiles.

2. There is a small store containing the heater for the hot water for scalding utensils.

3. A scullery for cleaning up; every opportunity is thus afforded for perfect cleanliness.

The cow byre consists of one byre for 20 cows. The centre is a loose box for sick cows, or those about to calve. Thus it is most conveniently situated in case of its being necessary to remove a cow during the night. Either box can be divided into two or four, by moveable partitions, if desired. They are isolated from the general byre by a cross ventilated lobby; this lobby allows air to enter the doors of the byre in a more gentle stream; here, too, will be kept the hose for washing down the byres.

Observation byres.—On purchasing fresh stock, some authorities insist that they shall pass the tuberculin test; it being obviously undesirable that possibly contaminated stock should enter the main byre, we therefore add a small detached byre for this purpose.

Construction of byres.—There is no doubt that most of the tuberculosis so commonly found in cattle is due to the great lack of ventilation in the byres; this is the more emphasised when the cows are stall-fed. The minimum ventilation required is very differently stated by various medical officers of health; since, however, the cow is an animal very susceptible to draughts, especially about the region of the udder, uniform diffusion of fresh air is therefore essential; cubic space is only of importance as rendering this feasible.

We allow 68 square feet per cow, which will permit adequate ventilation without draught.

The walls are of second quality salt-glazed bricks up to dado height, the cost of such bricks comparing favourably with that of cement, the latter requiring periodical cleaning and distempering. Above the dado the walls will be limewashed; the cows are placed down the centre, with a 4 ft. 6 in. granolithic passage back and front. In addition to the convenience and rapidity of cleaning and feeding thus given, a good air space is afforded round the cow's head; opening for air inlets can then be placed low down opposite the heads of the animals, there being sufficient room for the air to diffuse. Another advantage is that the cow neither breathes directly into another animal's face nor can a cow cough infective material on to a wall against which another may shortly afterwards be tied.

The cows are placed two and two, this being the most comfortable arrangement; between each pair is a thin sheet-iron partition; this is found to be preferable to wood, as it is not so prone to cause galls from cows constantly rubbing against it.

Special attention has been paid to keeping the udders clean by preventing the animals from lying in their own dung. To this end the floor nearest the manger is sunk two inches and a channel being made in each stall for drainage bedding is trampled down here; the remainder of the floor is sloped slightly back to a trench. Owing to the animals finding the front part more level and softer they do not tend to lie down in the trench. In this connexion the distance between the edge of the trench and the manger is of great importance and should vary with the size of the cow. For Ayrshires six feet is fairly correct; for Jerseys five feet three inches.

The floors will be made of concrete and roughed cement as being impervious and not slippery.

The mangers will be formed of earthenware and fixed to come flush against the front division to prevent the lodgment of débris. A separate one for each cow is best, the space between being filled in so that one cow cannot feed at another's expense.

Water is supplied in separate small enamelled iron troughs, placed higher than the manger so that food cannot drop into them. They should be easily removeable for cleaning and can be either filled by a separate tap or from a hose.

The trench for excrement is five inches deep by one foot four inches wide, and has a fall of 1 in 20; the two trenches on either side of the central passage open into a channel, covered by a four inch removeable grid; outside the byre the channel discharges into an inspection chamber and then through a trap to the main drain. Gratings are placed in accessible positions to intercept straw and other débris. The trench is sufficiently wide to prevent excrement entirely blocking it. It will be constructed in cement.

Ventilation is arranged so that there is a minimum fixed ventilation of 36 square inches per cow, that cannot be tampered with by an ignorant cow-keeper. This is insisted upon by the by-laws of some sanitary authorities. Gratings are fixed four feet from the floor, between the windows on the wall facing the heads of the animals; to diffuse the draught a board is fixed one inch from the wall over the opening. The external channel slopes sharply down, thus avoiding direct draughts and preventing the opening being easily stopped up. Louvres are provided along the roof; two-thirds of this area can be closed at will by boards worked from below by gearing. In addition the upper part of the windows open as a fanlight. The upper panels of the doors not opening directly on the byre are also pierced for ventilation. All doors for animals are on the sliding principle.

The floors are of concrete and cement, roughened to afford firm foot-hold.

The piggeries are on the east. They consist of sty and run. A meal mixing and boiling room is provided; refuse from the kitchen being very often offensive is delivered under an open verandah; it then passes through the mixing and boiling rooms and is run into cooling tanks outside, protected by a light roof.

We place a corrugated iron verandah over all the gangways; this does not interfere with ventilation of the runs, as its sides are entirely open, and it does not project over the run but is arranged for the protection of the farm attendants in snowy or wet weather.

The slaughter-house is altogether detached and contains no pens. It will be provided with hot water and drained by an open channel discharging on a drain outside. The wall will be cemented dado height and lime-washed above.

A louvred lantern is provided above and window openings are all fitted with regulating louvres.

Lavatories are placed conveniently for men working in the farm buildings.

On the east side is an implement shed for ploughs and harrows, which is reached from the farm fields.

Collection of milk from byres.—It will be noticed that the milk is to be collected from the cow byres and cooled by a special arrangement to which we wish to call particular attention. A small apartment is built on the external wall of the byre, and connected to the byre only by means of a small white glazed trough and channel discharging into the large milk can of commerce which, when full, will be wheeled on a truck to the dairy. The apartment referred to will be lined both walls and floor with white glazed bricks with rounded angles and ventilated at top and so arranged that it can be entirely flushed out by the hose. This method of collecting will obviate the necessity of milk being carried in the milking-pans through the cow byre and across the yard and has other obvious advantages in the form of cleanliness and as a labour-saving device.

SPECIFICATION OF BUILDING MATERIALS.

As the position of the site is not given to the competitors it is difficult to select the material which would become cheapest and most desirable for such a building as this is, but we have designed our edifice for the use of the following building materials which, of course, can be varied when the site is chosen.

The site will be generally cleared and all earth will be redeposited where required for making up levels, landscape gardening, &c. The site will be covered with cement concrete and the building kept well up to avoid all possibilities of damp.

The building throughout will be faced with stone, obtainable in the district, selected and dressed to form an irregular ashlar face. The quoins to angles, chimney stacks, &c., will be of the same stone, ashlar bonded. The external walls will be backed with brickwork, bonded to the stone facing. All internal walls will be brick.

All moulded work, dressings, &c., to administrative block and facades of towers, and also all lintels, sills, quoins, dressings, chimney stack caps, plinths, window dressings, &c., where shown throughout, are to be of stone.

Roofs will be covered with the best Carnarvon green slates.

The glazing to verandahs will be composed of clear glass

rolled round wire netting and will have the advantage of preventing any glass falling upon the patients below, should the roofing be accidentally broken.

These verandahs will have the underside of the glazing distempered with light green distemper during the summer time, which can be easily washed off by means of a hose when no longer required.

The materials and construction throughout will be "fire resisting" and as far as possible "fire proof."

Staircases will be of teak selected and specially constructed to avoid all dust, &c.

Throughout, except where glazed framing is shown, the partitions will be constructed of coke breeze concrete, five inches thick. They will combine the advantages of lightness, strength, and economy. They are sound and fireproof and will be found useful for fixing joinery, bedding plates, &c., and will only be required to be floated and set, thus avoiding the expense of rendering. The material to be mixed in the proportion of one portion of cement to six-and-half portions of coke breeze concrete, about three quarter inches diameter, and will be found to be cheaper than brickwork.

The joinery work throughout, with the exception of the verandahs which will be of Oregon pine, will be of the best seasoned "Bass" or "White" wood prepared for painting, this wood being more durable and less likely to warp and shrink than deal or pine.

The engine department will have a glazed brick dado four feet high and will be paved with granolithic paving.

The laundry buildings will have iron trusses and wood and iron lantern lights with open louvred sides. Louvres to be hinged to open.

Windows will be iron casements glazed with 21 oz. sheet glass.

Joinery will be deal, stained and varnished.

Floors to finishing and other rooms will be wood block, others granolithic.

The flooring to verandahs throughout to be of six inches red quarry tiles, to falls. The curb will be formed of a small York stone curb with rounded nosing, set and pointed up with cement.

The kitchen yard will be paved with stone, and floors of conglomerate mosaic.

All floors of corridors and single rooms will have American maple floors, secretly nailed. The walls will be of plaster and finished painted with sanitary paint varnished.

All joinery will be of bass wood painted white.

Walls of sanitary annexes, lavatories and bath-rooms, will be lined with glazed bricks, and paved with conglomerate mosaic laid to falls. Baths will be of Stourbridge ware with hard wood capping. Lavatory tops will be black enamelled slate with fixed basins, and the water-closets will be of the best "washdown" closets with hardwood lifting seats.

Hydrants will be supplied from the main supply in all the corridors.

The frieze shown upon the elevation surrounding the central and two side blocks will be a special and attractive feature, being carried out in bright colours with large pieces of coloured vitreous mosaic or slag glass, a method adopted with much success in Berlin and other large continental towns and specially recommended by us as being moderate in price, requiring no cleaning, novel, and extremely decorative in appearance.

ESTIMATED COST.

The estimated cost of the building has been gone very carefully into, the amounts we suggest being ample to provide for any contingencies and emergencies that may arise, thus doing away with the charges for "extras" which are so general in carrying out buildings of this class. The total cost, we think, compares favourably with other sanatoriums lately built, both in England and on the continent.

Not knowing the position of the site it has been difficult to give an accurate estimate of the total cost, but we give below the following detailed prices which can of necessity only be considered as approximate:—

	£	s.	d.
Main building, including kitchen block	38316	0	0
Boiler and engine-house, laundry, sputum destructor, and chimney shaft	3013	0	0
Investigation block and mortuary	1647	0	0
Stables	1562	0	0
Medical superintendent's house	1807	0	0
Lodge	900	0	0
Boilers and heating apparatus (as per estimate obtained)	2131	0	0
Carried forward	£48976	0	0

	£	s.	d.
Brought forward...	48976	0	0
Electric plant and lighting (as per estimate obtained)	2168	0	0
Laundry plant (as per estimate obtained)	772	0	0
Kitchen fittings (as per estimate obtained)... ...	463	0	0
Drainage (approximate)	1406	0	0
Ten house, shelters, and paths, fences, gates, and laying-out of grounds	2262	0	0
	£56047	0	0
Farm buildings	3326	0	0
Chapel	1951	0	0
	£61324	0	0

SUMMARY.

In the following summary we give a brief description of the designs which we suggest for a sanatorium. Our reasons for adopting the principles we advocate and discarding others are fully stated in the essay.

Our aim has been to construct a building with the necessary adjuncts, to carry out the requirements of the "open-air" method of treating tuberculosis in its entirety. Every detail of the structure has its purpose and we have introduced certain appliances which we believe to be entirely new to this class of building and which we maintain will be found to possess great advantages. We have discarded the idea of any place which does not give an equally uninterrupted view facing due south to every patient's room throughout the building.

The plan we have adopted is a central building with two-storeyed segmental wings, placed in the form of a curve, in front of which are deep verandahs. In front of the verandahs are grass plots surrounded by low railings. The rooms for the more necessitous classes are placed in the wings, whilst those for the well-to-do patients are in the central block. All the rooms, including the dining-rooms face south. The bed-rooms are approached from within by means of corridors—there is cross ventilation to all rooms, corridors, and lobbies by means of windows and fan-lights, the windows in the corridors being opposite the doors of the rooms.

Sanitary annexes are placed at the back of these wings and face the entrances from the grounds, which are in the centre of wings. These sanitary annexes are disconnected from the main building by specially designed cross-ventilated lobbies, having windows opposite to each other. Cloak-rooms for changing boots, &c., and heated for drying clothes, adjoin these entrances.

The rooms provided for the well-to-do patients are larger than those for the more necessitous classes, and a special dining-room has been arranged. Separate sanitary annexes are provided, and separate entrances from the grounds with a paved terrace.

The bedrooms on the ground floor have been so arranged as to ensure privacy.

The windows on both floors are French casements, opening to the floor, but in the lower section wooden doors are provided so that a couch may be drawn close to the window, and only the head and shoulders of the patient seen above it from the grounds.

The windows can be protected by louvre shutters in tempestuous weather.

On the second floor of the central block a recreation room has been provided. The objections to such an apartment have been overcome by placing windows all round, which can be opened together or separately, and the roof is moveable so that, provided rain is not falling, this unique room is practically converted into an open-air space.

There is ample bath-room accomodation, and the nurses' and attendants' rooms have been so arranged as to render their work as concentrated as possible.

The administrative block and kitchen offices are placed on the north side and are connected to the main building by a corridor centrally situated and so arranged that food will be directly delivered to the various dining rooms without crossing any open space or actually passing through or near any other department. We have specified the number of staff, medical and general, which we consider necessary.

The required consulting room, waiting rooms, offices, dispensary, store room, etc., have been placed leading off the entrance hall.

The main building has been made to look as attractive as possible. The verandahs and balconies have been so constructed as to afford shelter without interfering with light.

The buildings are of fireproof construction and provided with emergency staircases at all extremities.

Rooms are provided for assistant medical officers and also for a matron.

Ample store accommodation is provided both on ground and first floors.

A separate block has been provided for investigation purposes. A bacteriological and chemical laboratory have been designed, adjoining the post-mortem room and mortuary. A room for electrical work has also been placed in the same block.

Plans for an engine house, sputum destroyer, and a laundry, completely fitted, are also shown, and placed in a convenient position. We have paid special attention to the arrangement of the grounds for exercise and recreation.

We suggest a separate house for the medical superintendent, and also submit designs for the erection of a chapel and a farm.

The arrangements for the heating, ventilation, and drainage of the establishment are described, and we would draw the attention of the committee to the extensive employment of radiators which we suggest, both in the buildings and on the verandahs.

ESSAY AND PLANS FOR

THE ERECTION OF A SANATORIUM FOR TUBERCULOSIS.

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In association with GEOFFREY MORLAND, *Architect.*

THE IDEAL SANATORIUM.

IN the opinion of the authors of this essay the ideal sanatorium consists of a series of isolated huts, with windows on all four sides, in which the patients spend their whole time except when they are actually out in the grounds; here they sleep and have their meals, breathing the while an atmosphere beyond the risk of contamination. On a small scale this appears to be practicable; but for a sanatorium of 100 beds the difficulties of heating, of carrying meals, and of supervision over so large an area render the scheme impossible with due regard to economy.

The compromise.—The chief problem, then, is to effect a compromise whereby each patient's room obtains a maximum of sunshine and fresh air and yet is so placed as to insure economy of management. Hence the unit of our sanatorium is a room facing south, with unobstructed aspect, with a large window space, with a door on the north side opening on to a wide corridor in which there is a large window exactly opposite the door. These rooms occupy the whole south frontage and everything else has been made subservient to the one essential of providing that a current of pure air shall constantly flow through them.

THE SITE.

After much search the authors found a site which appeared to them an ideal one for the sanatorium and worked out the details of it on the spot. The chief features of the site are indicated on the plan (**Fig. 1**, page 60). The site chosen is the southern aspect of a hill running east and west and thickly covered with pine trees; in front the ground slopes gently down to a river, 100 feet below; behind there is a steep rise of 50 feet to the crest of the hill. Thus there is ample protection from north and north-east winds, and an extensive and pleasing view, including the meadows of the river-valley, a railway, the river itself, and wooded hills beyond—no mean factor in the treatment of a patient lying on a verandah. The hill ends somewhat abruptly on the east, so that a level pathway leads round to the northern slopes which are partially wooded and delightfully cool in summer. Walks of all degrees of steepness can be laid out up to the summit of the hill which commands also an extensive prospect to the north over forest land. The flat top of the hill is very suitable for a reservoir and a good level drill ground; in the grounds there are many protected spots suitable for open-air shelters. The soil is a deep bed of sand and gravel, so that there is dry walking after the heaviest rain. The meadows below the site afford ample pasture for cattle and for the treatment of sewage and there is a farm at a convenient distance. Meteorological observations taken in the neighbourhood show that it enjoys a mild winter climate with a small number of rainy days; and the summer heat is tempered by breezes from the sea, about eight miles distant, and by the coolness of the northern slopes.

THE GENERAL PLAN (FIG. 1, PAGE 60).

The sanatorium consists of the following separate buildings.

1. The *administrative block*, running north and south, with the main entrance on its west front; it contains the offices of the steward and matron and their residences above, a consulting room and dispensary, and the residences of the assistant medical officers.

2. The *sanatorium proper*, consisting of a central library and reading-room, with two diverging wings containing the patients' rooms, the whole forming a long curved south frontage. Each wing contains 44 patients' rooms, male and female respectively, with cloak and boot rooms, nurses' room, &c., and on the north aspect, detached, a sanitary block. A verandah runs along the whole front and covered ways connect with the library and dining hall.

3. The *annexe*, or quarters for the 12 well-to-do patients—a detached building to the east of the main frontage, and itself commanding a south aspect. Besides patients' own rooms it contains a large common room and library, cloak-room, kitchen, and nurses' room. There is no verandah, but at some little distance away are two colonies of *day huts* in which the patients spend the greater part of their time. The *annexe* is connected to the dining hall by a covered way.

4. The *dining hall*, situated to the north of the east wing, and accessible by covered ways. It is a lofty, one-storeyed building where all the patients can sit down at once; an alcove is set apart for the annexe and the staff. Three sides of the hall are composed principally of windows and the patients sit at small tables, each beneath a window. Along one side are pantries and a serving room and connected by a short, cross-ventilated passage is—

5. The *kitchen block*, with the usual offices, and accommodation above for all the female servants.

6. The *medical superintendent's house*, fronting the main drive.

7. The *laboratory block*, containing a large pathological laboratory with a post-mortem room and mortuary behind.

FIG. 1.

PLAN OF SANATORIUM
AND GROUNDS.
SCALE OF FEET
MEADOWS
MEADOWS
DRILL GROUND
RESERVOIR
ENGINE BLOCK
STABLES
ISOLATION
LABORATORY
DOCTOR
ADMINISTRATIVE BLOCK
KITCHEN BLOCK
DINING HALL
ANNEXE
BOWLING GREEN
CROQUET LAWN
PUTTING GREEN
EAST WING
HOSPITAL
LIBRARY
WING

8. The *nurses' house*, where the sister and nurses reside, situated between the dining hall and the annexe.

9. The *isolation block*, a small building, complete in itself, and at some distance from the others; here any accidental fever can be isolated.

10. The *engine block*, situated to the rear of the other buildings, and consisting of a laundry, electric plant, and pumping station, with a common boiler house. Here is also a room for the destruction of sputum and the sterilising of cups.

11. The *stables*, with rooms above for the men-servants.

12. The *gate lodge*.

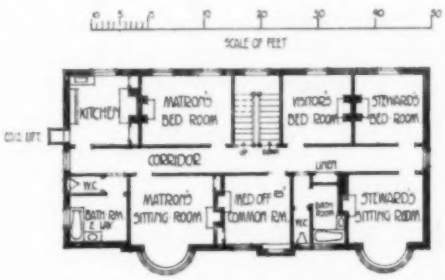
13. The *farm*, with byres, dairy, poultry-farm, &c.

Details of the various buildings follow.

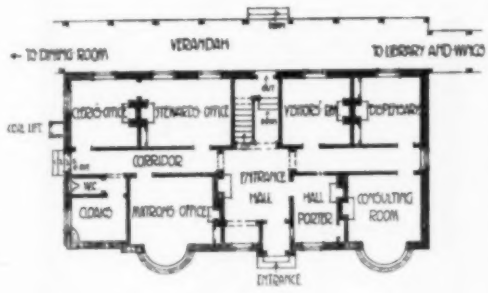
THE ADMINISTRATIVE BLOCK (FIG. 2).

Contains on the ground floor: Entrance-hall; hall porter's office, in which, besides the usual accessories, is the telephone exchange for all parts of the sanatorium; consulting-room; dispensary, which need not be large as but

FIG. 2.



First floor plan.



Ground floor plan.

few drugs are needed in a sanatorium; visitors' room; office of the steward or house-governor, who is the lay head of the establishment; office for clerk, or a private office if a clerk is not needed; matron's office; and cloak-room and lavatory. Along the east side runs a verandah, overlooking the croquet lawn, and along which the patients reach the dining hall.

On the first floor: Residence of the matron, with sitting- and bed-room, bath-room, &c., and a small kitchen (the latter is intended to provide small meals, such as supper, for the residents at a time when the general kitchen is not in use, it is also useful in heating water for the bath-rooms in this block); a hand-lift on the north wall is useful in bringing up coal, &c; residence of the steward; common room for assistant medical officers; visitors' bedroom.

In the attics.—Sitting- and bed-rooms for the two assistant medical officers; clerk's bedroom; bath-room, box-room, &c.

This building is all heated by open fires; the windows—as elsewhere—are double casements; the walls of brick covered with rough-cast.

THE SANATORIUM PROPER.

(See separate plans of the ground floor and part of the first floor of the west wing.)

Library.—In the centre is a lofty one-storeyed building known as the *library and reading-room*. This is the only "common room" provided for the patients, as it is intended that apart from meals they shall only meet in the open air: here are contained the lending library and tables for the daily and weekly journals. On the south side are two bay windows and a large open fireplace; on the north a verandah looking out on to a lawn and continuous with the covered ways to the wings and to the dining hall. This is one of the verandahs designed for use in summer, when the heat may become unbearable in those with a southern aspect.

Deflection to south.—The *wings* incline towards the south, and each is again subdivided into two blocks, the further of which is deflected still more, a total of 30°. This serves the double purpose of improving the general architectural effect and of providing great protection from wind to the south aspect and the verandah in front of it. Fig. 3*a*, page 62, shows the south elevation of the west wing, and Fig. 3*b*, page 62, shows the same in section.

Two storeys.—There are two storeys only—this again is a compromise; it would have been better from the point of view of open-air treatment to have had but one; this would, however, have unduly extended the frontage to 1000 ft. or more. The lower floor is raised a foot or two from the ground and freely ventilated beneath and there is no basement. The upper floor is practically a repetition of the lower and is accessible by a staircase at each end (Fig. 3*b*).

Corridor.—A corridor runs the whole length of the wing on its north aspect: out of it on the south side open all the patients' rooms and on the north side a nurses' room, linen-rooms, &c., but for the greater part of its length it is freely open to the air on this side and on the upper floor there are windows at the ends also. The corridor is six feet wide, giving ample room for passing and for trollies to be wheeled along it, for the purpose of economising labour in the collection and distribution of hot-water bottles, milk glasses, spit cups, &c., and there is a hand-lift to the upper corridor for the same purpose.

Verandah.—On the south front a verandah runs the whole length of the wing; at the ends it is continued round to the corridor doors; in the middle it expands into a sheltered *alcove* between the blocks. It is nine feet wide, roofed with glass and supported on plain square wooden posts with a three feet open balustrade between; it is 11 feet 6 inches high at the wall, 9 feet at the free edge, and the ends are left open for ventilation. The floor is tiled or cemented. Above the alcove is an *open-air gallery*, similar except in having an open roof; this is kept well aired by the louvred ventilator above which usefully carries a weathercock.

Apology for verandah.—The verandah is intended primarily for the use of patients who are unable to leave their beds or to walk, and who are wheeled out on to it from the lower rooms. It must be admitted that it somewhat interferes with the ventilation of the ground floor rooms, but this objection is minimised by making the verandah only as broad as it is high and by leaving it open at the ends. In passing it may be remarked that in the annexe (or well-to-do quarter) it is altogether omitted, but only by providing for the patients to be carried to their day huts as soon as they are well enough—an expense in labour too great on the larger scale.

Sanitary block.—On the north side of the wing, opposite to the junction between the two blocks, is a sanitary block, communicating with the corridor only by a cross-ventilated passage. Here are all the bath-rooms and water-closets. On each floor there are for the patients 4 bath-rooms with a douche also in each, and 5 water-closets, a maid's closet, and a room for brooms, &c., a closet for the store and cleaning of bed-pans with a high pressure flush for the same, and a separate lavatory for the nursing staff on duty.

Heating.—The heating apparatus is in the basement of this block: the system is one of low pressure hot water with radiators in the rooms and corridors and supplying hot water to the basins in the patients' rooms. As this water cannot be maintained at a uniformly high temperature a small separate boiler is also put in to supply baths and hot water-bottles in the sanitary block only.

DETAILS OF A PATIENT'S ROOM (FIGS. 4*a*, PAGE 62, AND 4*b* AND 4*c*, PAGE 63).

Aspect.—We now come to the consideration of the arrangement and furnishing of a patient's room: this must be in

FIG. 3a.

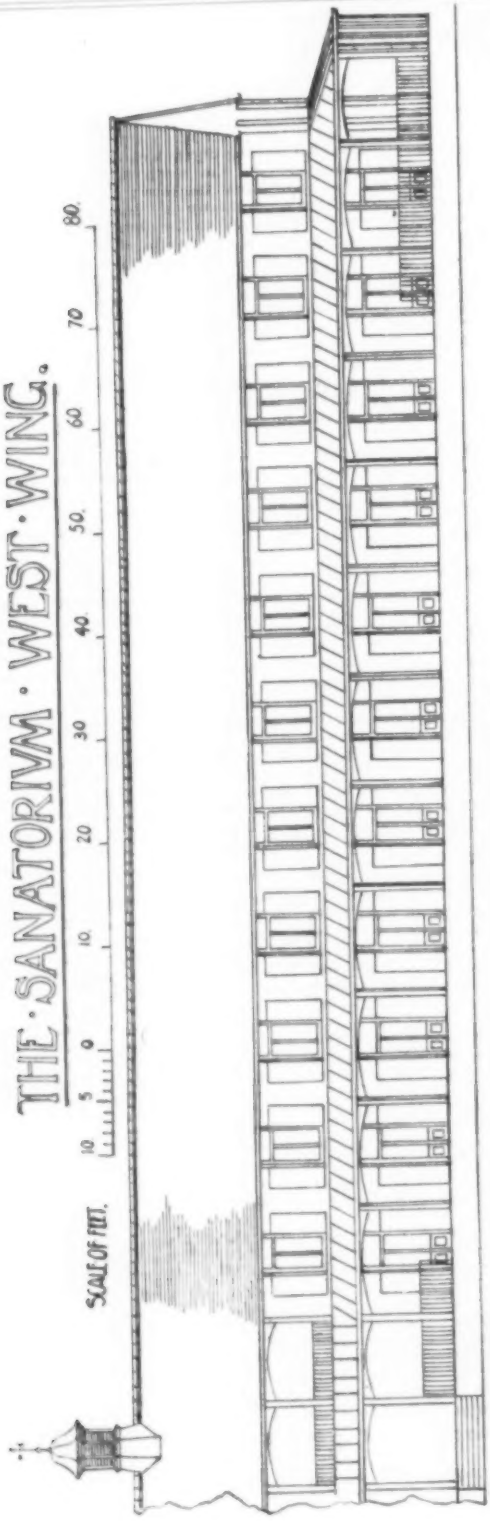
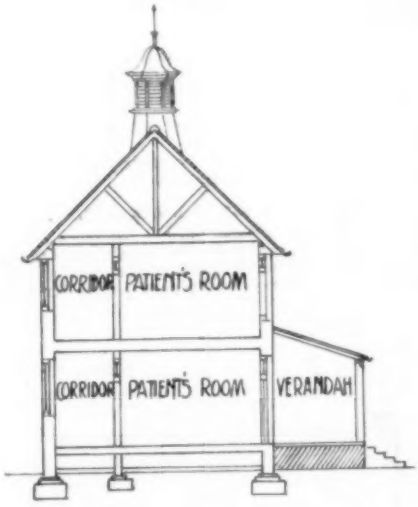
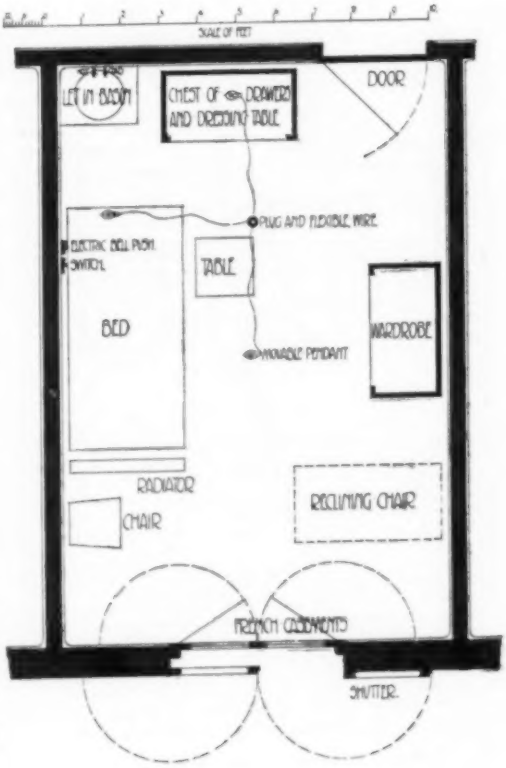


FIG. 3b.



Section of Fig. 3a.

FIG. 4a.



Plan of a patient's room.

detail as we are now dealing with essentials. Each room faces 15° or 30° to the east or west of south, ensuring sunshine from 8 A.M. to 4 P.M. when there is any, while the south-east rooms catch it at 4 A.M., and the south-west rooms retain it until 8 P.M. Each room is 15 feet long by 10 feet wide and 9 feet 6 inches high. The walls and ceilings are of plaster, covered with a washable distemper of some bright colour, with a darker dado (and stencilled border) of the same material. The floors are boarded and covered with a whole-coloured linoleum which is polished; it will be advisable to make the upper floor as sound proof as possible with silicate cotton or by other means.

Walls.—The angles of walls and ceilings are rounded off and along the floor is fixed a broad angle fillet which serves the additional purpose of keeping the linoleum in place. Thus there are no angles that cannot easily be reached with a damp cloth and floors and walls can be scrubbed; no cornice or picture rail is allowed.

Door and windows.—The door opens straight on to the corridor exactly opposite a large casement window in the latter; there is a hook to fasten the door wide open and over it is a fanlight which can be dropped to a right angle (Fig. 4*b*). The windows are double casements opening inwards, so that they can be folded right back against the wall and leave an open space. On the lower floor they open down to the ground, but the lower two feet are not glazed; on the upper they open above the verandah. They are 2 feet wide, with an opening of 4 feet; and above the opening is a large fanlight, 4 feet by 2 feet, hung in the middle, so as to be easily opened to a right angle. This gives a total of 57 square feet of clear window and door space. Windows and door are both made quite plain, with no mouldings and, as far as possible, with no ledges, hence the door-panels are flush with the frame, and the window-frame with the plaster of the walls (see details, Fig. 4*c*).

Shutters and blinds.—There are outside louvred shutters to the windows, the lower ones hinged in the ordinary way; the upper sliding so as to be easily closed from inside. They serve three purposes:—

1. To keep rain from blowing in.
2. As a shade from excessive sunshine.
3. To ensure privacy without closing the windows.

There are also light spring roller blinds on the windows, but no curtains of any kind.

Furniture.—The furniture of a room is reduced to the minimum consistent with comfort (Fig. 4*a*, page 62). It includes—

1. A *bed* on iron frame with rubber castors so as to be easily wheeled on to the verandah; wire mattress with hair mattress above covered with some easily brushed and fairly waterproof material, so that during the day the bed may be used as a couch after the clothes have been removed.
2. A light wicker *reclining chair*, which can be easily carried out on to the terrace or into the grounds.
3. *A chest of drawers* which can be used as a dressing table and a *wardrobe* which may conveniently have a large drawer underneath to contain the bed-clothes during the day. These should both be raised a foot from the ground on plain square legs so that dust cannot collect underneath; they must be devoid of mouldings and the top of the wardrobe may slope forwards to make it easily seen and cleaned.
4. A small wooden *table* covered with American cloth which can be easily cleaned if soiled with the spit cup; this is as cleanly as a far more expensive glass and metal table.
5. A bedroom *chair*.

And the following fixtures:—

6. A *let-in basin*, with hot and cold water laid on; this means an increased initial outlay, but by economizing labour will soon save its prime cost.
7. *A hot-water radiator* which can conveniently be placed along the foot of the bed, where it serves the purpose of a hot-water bottle, and is useful for airing the clothes and for drying towels.
8. *An incandescent lamp* of 16 candle power is attached by flexible wire to the centre of the ceiling, and its position can be changed at will by the ingenious device of attaching it to a rod and hanging it from one or other of several hooks in the ceiling.
9. An electric *bell-push* on the wall near the bed rings a bell in the nurse's duty room with an indicator attached.

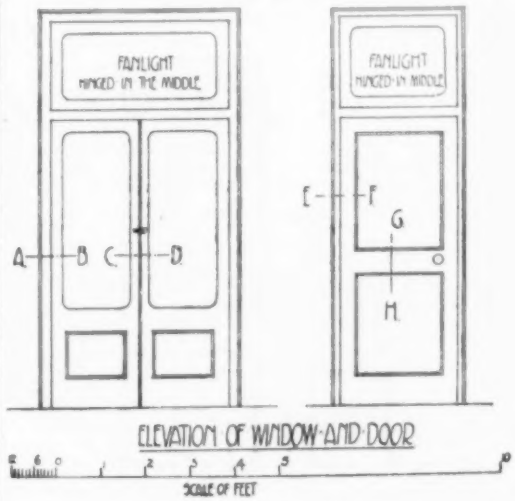
A couple of small mats, which can be easily brushed and stoved, are allowed to stand on. Boots and outdoor clothing are all kept in the boot and cloak rooms; and the patients—when well enough—are held responsible for keeping their rooms and washstands clean and tidy.

ROOMS NORTH OF CORRIDOR.

We now come to the few rooms on the north side of the corridor; beginning at the near or administrative end there are:

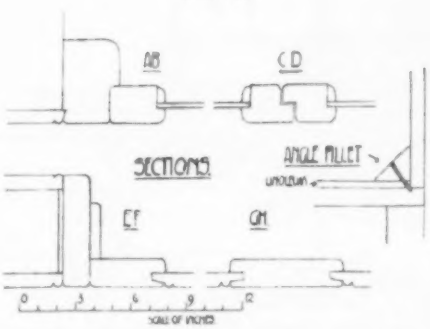
1. *Kitchen.*—An "*accessory*" *kitchen*, to be used as a "half-way house" between the kitchens proper and the patients who cannot leave their rooms; here milk can be heated, invalid food prepared, and meals kept warm; it is also used by the night nurse when the kitchens are closed.
2. *Nurse.*—Above this is the *nurse's duty room*, for the nurse on duty for the upper 22 beds of the block. This

FIG. 4*b*.



Details of door and window.

FIG. 4*c*.



room has an open fireplace; there are shelves for routine lotions and disinfectants and a few drugs such as may be wanted in emergency. Here also are the bell and indicator from the patients' rooms and the telephone to the hall porter's office, also a telephone, to be used by the night nurse only, to the room of the medical officer on duty.

Staircase.—Then comes one of the staircases to the upper floor; this being used constantly by patients should be constructed on sanitary lines as recently described, so that each step can be cleansed with a damp cloth from end to end; there are no corners or angles, as the step does not reach the wall or meet the "riser," and the balustrade is replaced by a "raking board" carried up parallel to the hand rail.

3 and 4. Next *two linen rooms*, one on each floor, with large cupboards all round and an airing cupboard.

It will be noted that these rooms have been arranged so as not to interfere with the ventilation of the patients' rooms; the doors of 21 and 22 open opposite the staircase, the windows of which are always open, while 20 is clear of the linen room. At the far end of the block are the following:

5. *A cloak room*, immediately adjoining the entrance from the grounds, and provided with numbered hooks for coats, &c., and boxes for hats and sticks; there are hot water pipes between the rows of hooks besides two large drying cupboards; there is a fireplace for summer when the hot water pipes are not in use.

6. Opening out of this is a *boot room*, where all the patients' boots are kept, and out of this again a *cleaning room* with a separate entrance from outside (5 and 6 have only a single storey).

Then comes the second staircase to the upper floor, and then:

7. A *nurse's duty room* for the ground floor patients.

Taken in detail, on the ground floor:

1. *An x-ray room* with localizing apparatus, and an adjacent dark room for developing the photographs.

2. Next come *two cells* intended to be used for such purposes as inhaling the vapour of creasote or formalin. Then the entrance and stairs, which are made sufficiently wide and shallow to admit of the carrying of a stretcher up and down.

On the upper floor:

3. An *operating theatre*, with windows on two sides and a skylight in addition; an open fireplace for use in winter when the radiators are insufficient. It may be surmised that its chief use will be for:

(*a*) Operations on lung and pleura, abscess, empyema.
(*b*) Operations on bone, psoas abscesses, opening up sinuses, possibly excision of joints.
(*c*) Operations for lupus and other skin lesions.

FIG. 5.

The "hospital" (at end of east wing).

8. And, over this, a *clinical room*, where any routine clinical work can be done, examinations of urine, sputum, &c., which it is not worth while to take to the laboratory; here also can be conveniently placed a lamp and apparatus for throat work.

THE "HOSPITAL" (FIG. 5).

It is probable that a certain number of cases of tuberculosis other than pulmonary will be admitted to the sanatorium; these, as well as exceptional cases of empyema and abscess of lung, will necessitate some provision for surgical treatment. Hence we propose to set aside the upper floor of the east wing, either wholly or in part, for these cases and to have an operating theatre and its accessories in convenient proximity. This will require a small wing built out from the end of the east wing, also utilising the roof of cloak and boot room; it has a separate entrance so as to be easily accessible from other parts, e.g., the annexe, and it also contains rooms for electrical diagnosis and treatment and other purposes.

4. An *instrument room* where splints and surgical dressings are also stored.

5. An *ante-room* for administering anæsthetics.

Then the staircase with a lavatory and water-closet opposite, over the entrance.

6. A room intended to be used for various kinds of electrical treatment if required, the Finsen light baths, and so forth.

Then come a passage leading to the surgical "ward" and a large balcony on to which beds can easily be wheeled, this facing east will be cool in summer when the rooms become very hot; the open-air gallery at the other end of the "ward" may also be reserved for these patients.

It will probably be convenient to collect here all patients of both sexes who require surgical dressings and the frequent services of a nurse but when approaching convalescence to move the men back again to their own wing of the sanatorium. A special nurse will be in charge and there is a nurse's duty room near to the end of the corridor.

Building materials.—It is proposed to construct these buildings of brick, covered with rough-cast so as to be completely weather-proof, except under the verandahs where there is a surface of good red brick. The roofs are of red tile, the woodwork is white, and the shutters are green, giving the whole a cheerful appearance.

THE ANNEXE.

(See ground floor and first floor of the annexe upon separate plans.)

Superior accommodation has to be provided for 12 well-to-do patients, and it was considered inadvisable for these to share a building or even to use the same corridors as the others. The annexe is designed for their accommodation and is complete in itself, except that the patients use part of the common dining hall.

Aspect.—The annexe stands back beyond the east wing of the main block; it faces 30° to the east of south, so that the east wing in no way obstructs its view, and it is connected to the dining hall by a long covered way.

General arrangement.—The general arrangement is the same as for the wings of the main block; there are six patients' rooms on each of two floors, all with a south aspect and with doors opening on to a corridor running along the north side. In the centre of the ground floor is a library and common room with a large bay window, and above it an open-air gallery, partially covered in. To the north of the corridor, detached, is a sanitary block, and on this side also are cloak- and boot-rooms, a boot-cleaning room, an accessory kitchen with a nurse's duty room above, and above the cloak-room a clinical room, store-room, and linen-room.

Terrace.—Around the whole building is a terrace on to which the corridor and library directly open. A verandah is not provided for reasons already given and the windows do not open down to the ground.

Details of room.—Each room is 16 feet long by 14 feet wide by 9 feet 6 inches high, the door opens opposite a corridor window, and there is a fanlight over. There are two double casement windows 4 feet by 3 feet 6 inches, with a fanlight over each. The casements open outwards, as there is no verandah, and are fixed by sliding stay-bars. The fanlights are hung in the middle. Each window is protected by an outside sun-blind. On the inside a light linen curtain is hung 6 inches from the window. The floors are of parqueterie polished with beeswax and turpentine; the walls are of plain unvarnished matchboarding for 4 feet 6 inches with an angle fillet below; the rest of the walls and the ceiling are of plaster distempered. Matching is used for the walls for the sake of warmth and comfort; if it is of some hard wood with V-grooves instead of beading there is no real difficulty in keeping it aseptic, and it will be noted that it is only used for the lower 4½ feet of the wall, where it is readily reached.

Furniture.—The fixtures and furniture are the same in kind as in the main block with the addition of a douche in a corner of each room with hot and cold water laid on and provided with a needle spray; it is surrounded by a waterproof curtain. There are two 16 c.p. lamps, one fixed at the bed head and the other moveable about the room as before described. In addition to the other furniture there may be a folding writing table. There are two hot-water radiators, one as before along the foot of the bed.

Library.—The library is a room 15 feet by 20 feet, and 12 feet high; it has a large open fireplace, a bay window, and two French windows opening on to the terrace. There are book-shelves, tables for daily and weekly papers, and 2 or 3 lounges. This again is the only common room provided for the annexe patients; the deprivation may appear to be severe, but it is the only really effective method of accustoming them to an outdoor life. A billiard-room is out of the question as, under the conditions of the treatment, a table would soon be worthless. Above the library is an open-air gallery, reached by a few steps from the upper corridor, and open in front except for pillars; the bay is tiled and accessible from this.

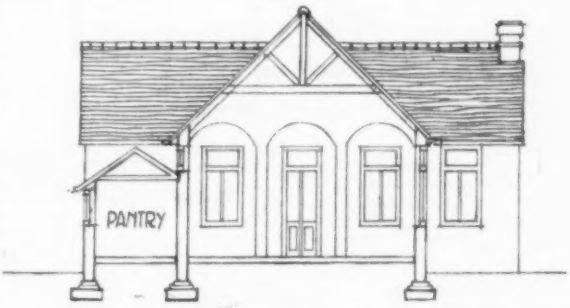
Day huts.—Some little way from the annexe and at a higher level are the day huts arranged in two settlements of 6 each; in front of each group is a terrace and behind a lavatory conveniently placed. The huts are protected by trees but with an unobstructed view to the south. Each is 10 feet square with two windows on each side; these are sashes and completely disappear; on the south side louvred shutters can take their place when necessary.

The huts are raised from the ground on piles, on a framework of wood with a painted galvanised iron roof; the walls do not quite reach the roof, giving additional ventilation beneath the eaves. The floor is boarded and covered with linoleum; the walls and open roof with compo boarding with a broad beading nailed over the junctions and varnished. In each hut are a wicker reclining chair (and if necessary a bed) and a writing table; and each is well lighted with a 16 c.p. lamp. The day huts are to be connected with the annexe by a smooth asphalte path of gentle gradient, along which a bed-patient can be easily and comfortably transported in a "spinal" carriage.

THE DINING HALL (FIG. 6*a* AND 6*b*).

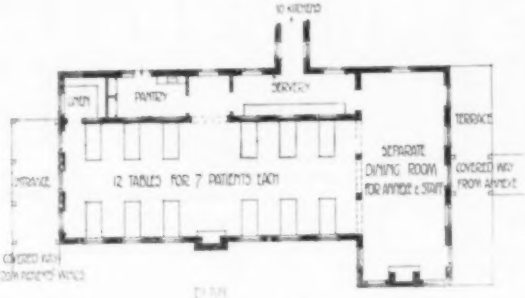
General description.—This is a detached one-storeyed building (Fig. 6*a*) with an open roof. In the long arm, which is 56 feet by 22 feet, are 12 tables for the ordinary patients; these seat 7 apiece, each under a window (Fig. 6*b*). This arrangement brings the patients into much less intimate contact than at one long table and renders supervision more easy and less pointed; moreover, classification is possible, the "surgical" patients being separated from the others and those with excessive expectoration kept apart. In the cross-piece of the T are four smaller tables for the annexe and staff. The nurses dine at a different time.

FIG. 6*a*.



Section.

FIG. 6*b*.



The dining hall.

Accessories.—On the north side of the hall are:—

1. A *serving room*, where all the carving is done; this is provided with a long steam-heated carving-table with hot cupboards beneath for plates; it opens separately into the two parts of the dining hall.

2. A *pantry*, where all the utensils are washed and stored, so that plates, &c., used by patients never go into the kitchen block.

3. A room for table-linen, serviettes, &c., and the numbered linen bags in which the patients' serviettes are kept.

Access.—The hall is reached along the verandah on the east side of the administrative block and from the annexe by the covered way. The servery is connected to the kitchen by a short covered passage.

Details.—There are two large open fireplaces, one in each section. The windows are casements with fanlights over on three sides, opening to the ground at the ends; on the north side there are fanlights only above the level of the pantry and servery roof. There are sun-blinds to the south windows. The floor is of wood blocks, the walls being match-boarded.

This hall is intended to be used also as a chapel and an American organ can be placed in the east wing opposite the fireplace.

2. Adjoining the kitchen is a *scullery* and from it a covered way leading to the boiler-house, coal-store, &c.

3. A large *servants' dining-room* with a separate door for the men-servants, and with pantry attached.

4. The *housekeeper's room* and her store.

5. A *servants' hall.*

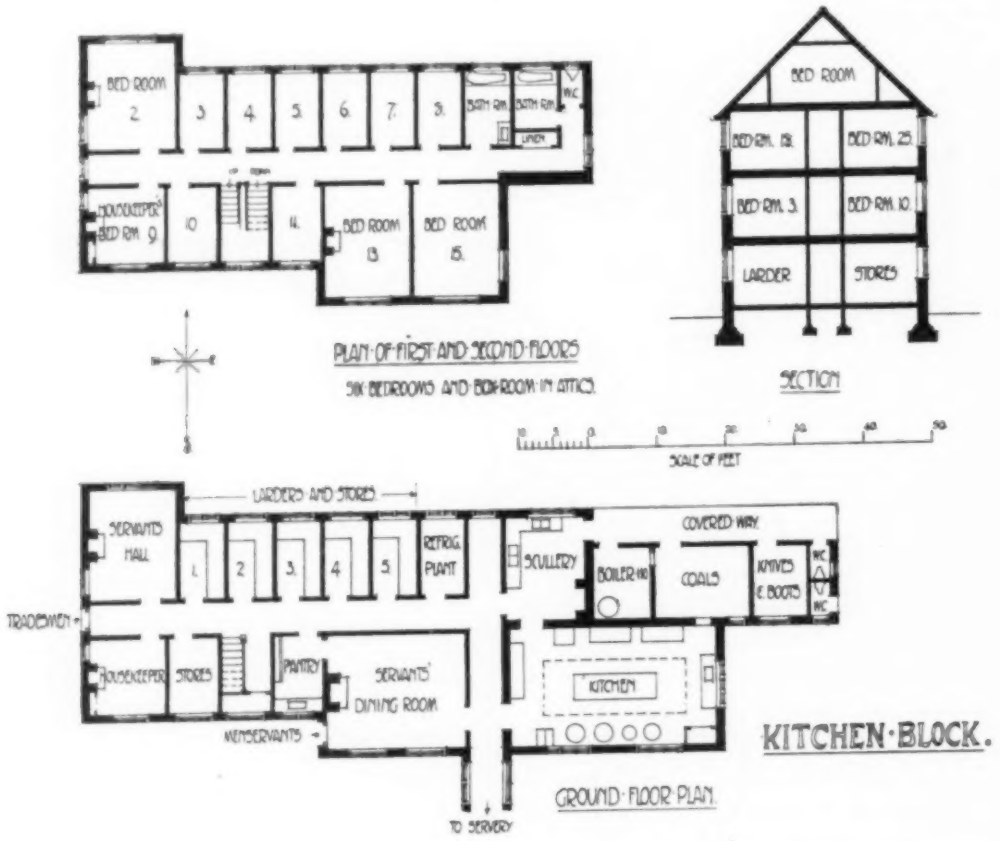
6. On the north side a row of 6 rooms for 8 larders and stores, with refrigerating plant at one end.

On the first and second floors are bedrooms for from 35 to 40 maid-servants, and there are a few extra rooms in the attics.

THE MEDICAL SUPERINTENDENT'S HOUSE.

This is situated fronting the main drive. It is a two-storeyed house with three sitting- and five bed-rooms and communicates with the administrative block by telephone.

FIG. 7.



THE KITCHEN BLOCK (FIG. 7).

This lies immediately to the north of the dining hall, with which it is connected by a short passage. On the ground floor are:—

1. The *kitchen*, which is one-storeyed, top-lighted, and ventilated by a fan working at the bottom of a long shaft. Cooking is done partly by ordinary ranges and partly by steam; there will be two cooks, one for the ordinary patients, the other for the annexe and staff, and the apparatus must be in part kept distinct. The following will be required: two kitcheners, one of which should have an open fire for roasting; two large wet steam-ovens, for vegetables, fish, puddings, &c.; two or three circular jacketed boiling pans, one for beef-tea; a large baker's oven for bread and pastry, and down the middle of the kitchen runs a long hot plate.

THE LABORATORY BLOCK (FIG. 8, PAGE 67).

This is situated behind and within convenient reach of the medical superintendent's house, and contains a well-equipped pathological laboratory, with a post-mortem room and mortuary behind, and a lavatory.

All the apparatus in the laboratory can most conveniently be electrical; the lighting is by incandescent lamps and the heating is by electric radiators; the incubators have electrical regulators and ventilation is carried on by an electric fan. Apart from the convenience of these methods they will insure a practical absence of dust. The equipment for the rest is that of the usual pathological laboratory, the medical superintendent determining the particular kind of research which is to be carried on. Probably one of the assistant medical officers will devote most of his time to this branch of work.

FIG. 8.

The laboratory block.

THE NURSES' HOUSE.

The regular nursing staff will be 10 in number, viz.:—

A sister, who will be responsible for the nursing generally; she will assist at operations and accompany the superintendent on his rounds.

6 day nurses—2 for each wing (one to 22 patients), one for the annexe (one to 12 patients), and one for the special surgical work.

3 night nurses—one each for the wings and the annexe.

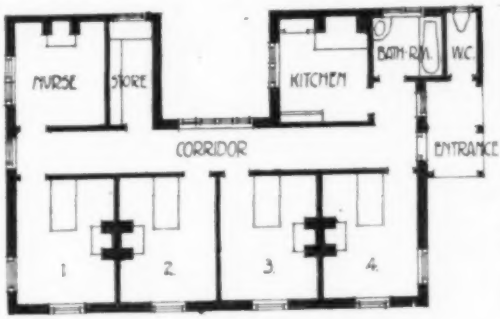
In addition to this, accommodation must be provided for one or two special nurses for bad cases and a nurse may be required for the isolation block.

The nurses' house stands back to the north of the covered way from the annexe to the dining hall. There are 3 sitting-rooms, all facing south: these are a common room where meals are served, a writing room, and the sister's sitting room; 12 bedrooms (3 on the ground and 9 on the first floor), the usual offices, and a small kitchen which may be used to provide breakfast and supper, the nurses dining in the common hall. All the rooms are heated by open fires; the common and writing rooms open by French windows on to a terrace with a garden in front. A telephone in the hall communicates with the administrative block. Two maids are necessary for the housework.

THE ISOLATION BLOCK (FIG. 9).

In case of any infectious fever breaking out in the sanatorium or being accidentally introduced it will be necessary to have a small block for isolation as a preliminary to removal to a fever hospital if of a notifiable character.

FIG. 9.



The isolation block.

This block should be situated at a considerable distance from the others and be complete in itself. It contains 4 separate rooms, with a nurse's room, kitchen, bath-room and lavatory.

THE ENGINE BLOCK (FIG. 10. PAGE 68).

This is a large block, situated a considerable distance to the rear of the kitchen block; it is one-storeyed and contains the laundry, electrical generating station, pumping station, disinfectors, and a boiler house common to them all.

Laundry.—The laundry is a long building about 100 by 30 feet. At one end is a receiving-room where all the clothes enter, except such as come from the isolation block or such as it is desirable for other reasons to disinfect before washing; these latter are taken by a separate entrance into the disinfecting room, where they are passed through a Washington Lyons steam disinfector provided with a vacuum apparatus; at the other end they reach the receiving room and are then ready to enter the laundry.

The main part of the laundry is a single room, one side of which is the washhouse and the other the ironing and finishing room. Right down the centre of the room is a subway which carries the shafting of the engine and also all steam and water-pipes, electric cable, and drains; and on each side of this are arranged the machinery—washing on one side, ironing on the other—so that the work passes uninterruptedly from one to another. At one end is an ironing-room with a stove and airing-trays, and a drying-closet with eight sliding horses and a hot-air blast. Ventilation is maintained by an extracting fan in the roof worked by the shafting.

Staff.—At the far end is a despatch-room, opening on to a covered entry; and a large store and mending-room, where all the mending is done before the clothes leave the laundry. The laundry is worked by a staff of 8, including the manageress, 4 of whom should be skilled hands and an extra hand for mending.

Engine-room.—The engine-room is a long room between the laundry and boiler-house, containing all the machinery—viz., a donkey-pump to deliver 900 gallons an hour for the boilers and laundry, using for this purpose rain-water from the roofs of the whole sanatorium; an 8 horse-power high speed horizontal engine for the laundry; a 25 horse-power engine for the dynamo; and a water-heater worked by exhaust steam from the engines. One end is devoted to a fitter's shop.

Boilers.—The boiler-house contains 2 Cornish boilers, 20 feet by 5 feet, with an economizer so as to avoid all smoke from the chimney; the coal-bunkers have tanks above.

Pump.—A pumping-station has been put here if, as is probable, a plentiful supply of water can be obtained from a well in this situation; the water is raised to an open reservoir on the crest of the hill, and then is conducted to cisterns in each separate block of the sanatorium.

Electric plant.—The electrical plant is designed to light the whole of the buildings, including the verandahs and open-air shelters. It is estimated that this will require 550 16 candle-power and 400 8 candle-power incandescent lamps, with eight arc-lamps for the grounds, a power of about 50 kilowatts, or 250 ampères at 200 volts; but only two-thirds of this is likely to be required at any one time. To give this put down a 25 break horse-power engine coupled to a dynamo capable of giving 60 ampères at 200 to 275 volts. The engine runs all day, charging a battery of 110 "R.G. 7" cells; between 6 and 8 P.M., during the time of big demand, the engine and battery are put in parallel; then, when the load drops sufficiently, the engine is shut down and the battery takes all the lights. The current is distributed to the buildings by concentric cables drawn into underground iron pipes; it is carried about the grounds by insulated twin cables slung on wire, utilizing trees as posts.

As it is of the greatest importance to induce the patients to stay out of doors at all times it will be found advisable to light the verandah brightly, as well as the day huts and other open-air shelters. The current is controlled from a switchboard in the main hall, and all the usual safety devices are employed.

Disinfection of sputum.—The other room is a disinfecting room for sputum. Here are brought all the spit cups from the sanatorium; the sputum is emptied out into boxes containing sawdust, which are put on the furnaces, or if thought advisable in a special incinerator. The cups and flasks are then all boiled before being taken back; a very convenient apparatus for this purpose is a steriliser in which boiling soda solution mechanically rotates and flushes the vessels which are fixed on a revolving frame.

THE STABLES.

Form a u-shaped building inclosing a paved yard. Below are 3 stalls for horses and a loose box; coach-houses for an ambulance, a wagonette, and two traps; a harness room,

bicycle shed, and rooms for fodder, &c. Above are bedrooms for 8 men-servants. There will probably be a greater number of men-servants than this, but it is assumed that some of them will be married, and there might suitably be a row of cottages for these down by the farm.

THE FARM.

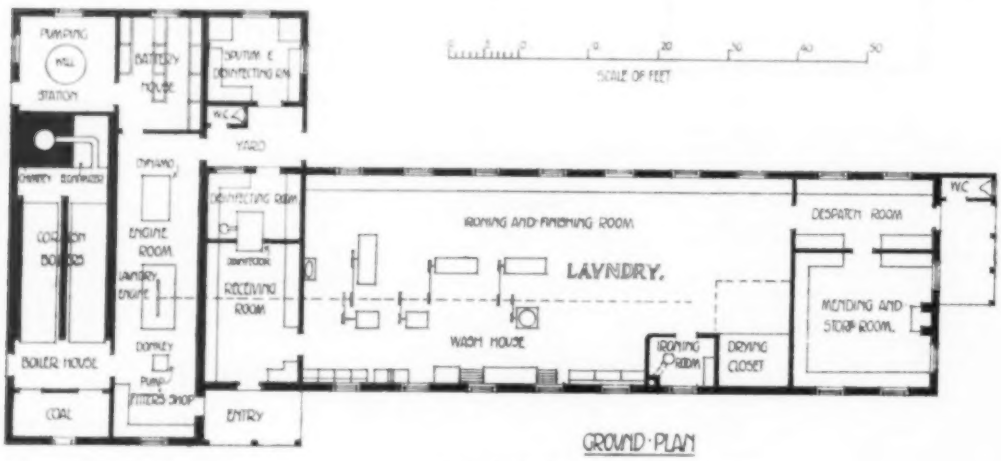
Close to the site selected for the sanatorium is a large expanse of good meadow-land, with excellent grazing for cattle; for this reason and for the sake of having an absolute control of the quality and purity of the milk it will be worth while for the sanatorium to possess its own dairy farm. Moreover, the amount of waste food will be found sufficient to feed pigs and poultry; the latter will afford a useful outdoor interest for the patients.

to the north of the east wing, where two verandahs look out on to them. One of the latter is a verandah built specially for use in hot weather, when the south ones are unsuitable. A bowling-green may also be laid out; tennis is inadmissible. Various other games, such as skittles and quoits (rope, not metal), are permitted.

Apart from games, patients should be encouraged when well enough to take an interest in the farm and garden; the chicken-farm may afford them useful work, also light work in the garden, digging and planting, under the direction of the gardener. An aquarium, an aviary, and an apiary may all serve to increase their interest in outdoor life.

For some patients systematic bar-bell exercises may be deemed advisable, and a very suitable drill-ground for this purpose will be found on the ridge of the hill.

FIG. 10.



The engine block.

Dairy.—The consumption of milk will approach half a gallon a head, or 50 gallons daily for patients alone; this will be, of course, unskimmed, and if cream and butter are to be obtained the separated milk from these may be used for the pigs. This will require a herd of some 60 cows, with pasture land of 200 acres or so, if hay is used for fodder. Only cows which do not react to the tuberculin test are kept. The byres and dairy are to be model ones and no pains spared to keep the milk aseptic. The milkers wear clean white aprons and are specially instructed in the care of their hands and the milk is filtered into the milk pails. After this it is sterilised in bulk and sent up to the sanatorium in sealed cans.

DRAINAGE SYSTEM.

The sewers are intended to be laid on the separate system. The water from the roofs first fills large rain-water tanks for the supply of all the boilers and the laundry; the surplus along with the rest of the storm water discharges into the river direct. The sewage and slop water are conducted along separate drains, with an automatic flushing syphon at the extreme head of each, to the sewage disposal works. Here the treatment depends on the nature of the site, soil, &c., and the area of land at disposal. Probably bacteria-beds followed by treatment on the soil will meet the case.

RECREATION.

Recreations at a sanatorium are necessarily limited to those which are taken in the open air and which do not involve violent exercise. Undoubtedly the most generally applicable recreation is walking about the grounds, which should for this purpose be tastefully laid out, with seats at frequent intervals, and with open-air shelters, both in protected localities and at good view-points. Shelters can be quite suitably and cheaply constructed by a joiner, of wood felled on the grounds, for the most part facing south. Of outdoor games, croquet and putting are very suitable, and two lawns have been laid out for this purpose in the very sheltered area

APPENDIX.

NUMBER OF INMATES.

PATIENTS.

Ordinary	88
Well-to-do	12—Total, 100

STAFF.

Medical—Superintendent	1
Assistant medical officers	2—3
Nursing—Matron	1
Nurses	9—10
Executive—Steward	1
Clerk	1—2
Men servants—Hall porter	1
Engineers	2
Laboratory and dispensary boy	1
Porters	2
Boots	2
Night watchman	1
Coachman and groom ...	2
Gardener	1—12
Maid servants—Housekeeper ...	1
Cooks	2
Kitchen maids	2
Parlour maids	4
Maids for matron	1
Nurses' house ...	2
Annexe	2
Wings	8
Administration block	1
Kitchen block ...	3
Manageress and laundry maids	8
Mending maid	1—35—Total, 62

THE LANCET.

LONDON: SATURDAY, JANUARY 3, 1903.

1903.

IN approaching the eighty-first year of our issue let us commence by wishing our readers all happiness and prosperity and by assuring them that so far as lies in our power we shall endeavour, as in the past, to promote their professional interests and to record for their instruction the history of medicine as it is made from day to day all the world over. Hitherto it has been our custom, as evidence of the range of our ambitions, to present to our audience in the first number of THE LANCET for each year a sort of microcosm of medicine and surgery. In these days it is impossible for the covers of any one issue of a journal to contain more than samples of work done in medicine, surgery, and obstetrics—to say nothing of the ancillary sciences, but it has been our aim to choose those samples from fields of widely varying interest in making up the opening issue of a new year. This year it will at first sight seem that we have made an entire departure from our custom. We have specialised to an extreme degree, for we have devoted practically the whole of our space to the reproduction of the three essays which recently gained prizes in the competition in connexion with the KING'S sanatorium. But the specialisation is more apparent than real.

In undertaking to publish these essays we were aware that unless we were prepared to issue them unabbreviated and fully illustrated the purpose that both HIS MAJESTY'S Advisory Committee and ourselves had in view would be defeated. We have therefore surrendered practically all our pages to these essays, feeling sure that our readers will understand their importance as epitomes of modern knowledge in its application to the prevention of a terrible and widespread disease. Moreover, these essays cover a far wider field than merely the prevention and treatment of tuberculosis, while the same may be said for the circumstances in which they were written. The gift of an immense sum of money for the promotion of practical therapeutics, the decision by which this sum was allocated to the construction of a model institution for tuberculous patients, and the spontaneous outburst of approval which met the publication of the KING'S decision, all alike show that the foundation of a Royal sanatorium has been regarded by the whole nation, from the Sovereign to the beggar, as a practical expression of human progress—a proof that in the twentieth century it is intended by those with riches and power to do their utmost to counteract the evil influences of disease. When the KING'S sanatorium is in working order a house of healing will be provided where those severely wounded in the fight with tuberculosis may be nursed and where those who are on the point of yielding to the attacks of this ubiquitous and insidious foe may be strengthened and their defences made doubly sure. Such an institution will be enormously far-reaching for good if in its working it attains only to a fraction of its estimated value. For not only will the KING'S sanatorium for consumption prove, when its benefits are in evidence, a perpetual incentive to similar endeavour, whether on the part of municipalities or of generous plutocrats such as Sir ERNEST CASSEL; but it will also convince all thoughtful persons that the means of prophylaxis against tuberculosis are in no way different from those against other diseases. Pure air, sunlight, pure water, good food, and a healthy environment could, if procurable in a great city, banish most diseases or cause them to be as rare in this country as are leprosy, plague, and cholera. Every line of the three prize essays which we publish to-day shows the enormous importance that is now attached, and for sound scientific reasons, to a healthy environment in the prevention and treatment of disease; and so, special as their subject and object may be, their lessons are of the broadest possible medical consequence.

The purview of modern medical life is so wide that no two people would agree where the boundaries of scientific medicine are set. For more than three-quarters of a century we have tried, and we think from the generous support accorded to us we may say that we have tried with success, to deal with the range of subjects included in the word medicine, a range that yearly—almost hourly—embraces more subjects for thought and discussion. While medical science proper and all those branches of knowledge, the study of which is inextricably interwoven with the study of medicine, progress so vigorously the practical questions and problems of professional life multiply in direct proportion. The relations of the State to the medical profession, the medical aspect of modern legislation, the attitude of municipal authorities towards medical men, the position of medical officers in the navy and army medical services, the medical side of educational questions created by the action of school boards, public views on vaccination, and public need of pure water-supplies—these things are but examples of the subjects with regard to which we endeavour week by week to give the medical profession information that should interest or help them, while we accept the grave responsibility of advising our readers as to the course which it would be best and safest for them to take in the many circumstances of difficulty or delicacy which are constantly occurring in the private or public life of a medical man. These circumstances increase in number *pari passu* with the growing complexity of modern life, and we make no claim to infallibility in respect of our advice, urging only our genuine desire to be helpful. The fact that we continue to possess the trust of our professional brethren makes us believe that our desire is generally realised and inspires us to further efforts for the year upon which we are now entering. And that year will not be an easy one for those who have the good of their profession at heart. The politico-social side of medical life is in an unsettled state and the wide subject of medical reform must continue to engage the attention of the bulk of the medical profession. The term "medical reform" has been made a cloak for visionary schemes and has led to frothy declamation, but while the misuse of hospitals is rife and while the sweating of

medical practitioners by wealthy confederations of workmen and tradesmen continues to be successful, there is plenty of room for sober and serious agitation with a view to getting such abuses remedied. We are proud to think that the investigations of our Special Commissioner have had the effect in many parts of the country of defining grievances and of bringing about solidarity of agitation, with the result that many medical men are now in a position to resist unfair demands upon their time and labour, to the benefit of their patients no less than of themselves. We hope that the year, upon the threshold of which we now stand, will see a development of the spirit of professional unity among medical men.

Annotations.

"Ne quid nimis."

REMOVAL OF FOREIGN BODIES FROM THE ŒSOPHAGUS.

MANY foreign bodies are arrested in the œsophagus. Fish bones are very frequent offenders, but their removal is generally not difficult; by the use of a hair probang they are either readily drawn up or pushed down into the stomach and nothing more is heard of them. But larger foreign bodies may give rise to great difficulties. Especially troublesome are coins and tooth plates. Children are very prone to put coins in their mouths, partly because it is natural at an early age to test all things with the aid of the taste, and partly because it seems to them that the mouth is a safe hiding place for articles of such value as coins. Whatever the reason may be for the practice, a sudden movement or an incautious inspiration sends the coin backwards into the pharynx, whence it occasionally falls into the larynx, but far more commonly passes into the œsophagus. Sometimes, if small, the coin progresses uninterruptedly into the stomach and so onwards until it makes its appearance in a motion. Not rarely, however, the coin, especially if it is as large as a halfpenny, lodges in the œsophagus, failing to pass. In adults the denture takes the place as regards frequency occupied by the coin in childhood. The tooth plate is not removed, as it should be, at night and the owner wakes in the morning to find it gone; it catches somewhere in the œsophagus and for this its shape renders it peculiarly liable. Both coins and dentures are removed from the œsophagus with difficulty. The instrument chiefly employed, the coin-catcher, easily slips by the foreign body or when it catches it does not take it at the best angle, with the result that the wall of the œsophagus is liable to be damaged by the manipulation. The use of forceps is even more troublesome. The Roentgen rays served to locate these bodies and thus afforded much help in their extraction, but the full amount of the assistance the rays can render was not appreciated until the idea occurred that the fluorescent screen could be utilised during the process of extraction, the shadow of the object could be seen, and also the shadow of the coin-catcher or forceps employed for its extraction. The foreign body could be seized in the most advantageous aspect and could be extracted with a minimum of damage to the œsophageal wall. We have published in THE LANCET recently two instances of this mode of procedure.[1] The neck and upper part of the chest are fairly translucent to a good focus tube and the foreign body and the instrument can be seen clearly.

[1] THE LANCET, Dec. 6th (p. 1540) and 13th (p. 1623), 1902.

COGNAC BRANDY AND ITS SUBSTITUTES.

WE note with satisfaction, in view of the conclusions recently expressed by THE LANCET Special Analytical Commission on Brandy, that at a meeting of the general committee of the Wine and Spirit Association the following resolution was carried unanimously: "That this association suggests to the Syndicat du Commerce des Eaux de Vie the desirability, not only of confining the use of the word Cognac to brandy produced in the Charentes, but of limiting its user to brandy distilled from pure grape juice only." If that should prove to be impossible the alternative, it is suggested, should be "that the Syndicat should take immediate steps to ensure that all pure grape brandies shall be shipped with an official stamp or certificate or other guarantee of their purity." At the same meeting of the Wine and Spirit Association the report of the Special Analytical Commission of THE LANCET[1] on Brandy was laid upon the table and discussed. It is gratifying to find that the attitude adopted by this important association is in complete accord with the views expressed in our report.

[1] THE LANCET Special Analytical Commission on Brandy, THE LANCET, Nov. 29th, 1902, p. 1503.

DEATH TRAPS.

IN THE LANCET of April 26th, 1902, p. 1202, we commented upon the loss of seven lives from fire in a house in Hackney. The house in question was at the back of a built-out shop and there was no exit from the house but through the shop or over the roof of the shop. Exactly the same thing has now happened in Stepney, six lives being lost. The built-out shop caught fire and cut off exit from, or approach to, the house. One inmate only, being awakened early, managed to get out on to the roof of the shop, which was already blazing, and by running along the roofs of the adjoining shops, which seem to be built in the same way, was able to give an alarm. When the fire-engines arrived, which they did within five minutes of the call, the shop was blazing so fiercely that there was no chance of getting the escape anywhere near the dwelling-house, and this, too, was a mass of fire. In our former note upon this subject we said that such erections never should have been allowed. They are nothing more or less than death traps and although we take it that all such existing buildings cannot be pulled down yet surely the London County Council can prohibit the erection of new buildings designed after the same fashion. At this moment, however, there is a row of flats being put up in the Edgware-road with projecting shops on the ground floor and apparently there is no exit from the flats except through, or rather between, the shops. If these shops should catch fire the inhabitants of the flats immediately behind them would be practically doomed. If the County Council has no power to prevent the building of such abominations it should apply for powers without delay.

THE DURBAR HONOURS.

AMONG the recipients of the Durbar Honours will be found the following well-known members of the medical profession whose work has lain in India. Dr. George Watt, C.I.E., officer in charge of the Economic and Art Section of the Indian Museum, Calcutta, has received the honour of Knighthood. Surgeon-General William Roe Hooper, President of the Medical Board at the India Office, has been appointed Knight Commander of the Star of India. Surgeon-General

Benjamin Franklin, Director-General of the Indian Medical Service, has been appointed Knight Commander of the Order of the Indian Empire. Lieutenant-Colonel Gerald Bomford, Indian Medical Service, Principal of the Medical College, Calcutta, and Major Alfred William Alcock, F.R.S., Indian Medical Service, superintendent of the Indian Museum, have been appointed Companions of the Order of the Indian Empire. Lieutenant-Colonel Robert William Steele Lyons, Indian Medical Service, superintendent of Dharwar Lunatic Asylum, and Major David Semple, Royal Army Medical Corps, Director of the Pasteur Institute, Kasauli, have received the Kaisar-I-Hind medal.

Mr. W. W. Astor has given £50,000 to the Hospital for Sick Children, Great Ormond-street, London, W.C., as a fund for the building of a new out-patients' department, to be dedicated to the memory of his daughter, recently deceased. The visitors from King Edward's Hospital Fund for London have more than once condemned the out-patients' department and Mr. Astor's gift will enable the committee to put the department into a thoroughly efficient condition.

Sir John Williams, Bart., who has been in attendance upon H.R.H. the Princess of Wales during her recent *accouchement*, has received from His Majesty the King the honour of being made a K.C.V.O.

WE have received a copy of the Medical Directory for 1903, which is now issued as a royal octavo volume, an improvement in shape which reduces the number of pages materially. We shall comment later upon some of the interesting features of the latest edition of this excellent book of reference.

His Excellency the Lord Lieutenant of Ireland has intimated his intention of conferring the honour of knighthood upon Mr. Charles B. Ball, M.D. T.C.D., F.R.C.S. Irel., Regius Professor of Surgery, Trinity College, Dublin.

AT the recent annual election of office-bearers at the Royal College of Physicians of Edinburgh, Dr. T. S. Clouston was appointed President for the ensuing year.

Looking Back.

FROM

THE LANCET, *SATURDAY, JAN.* 1, 1825.

HOSPITAL REPORTS.

ST. THOMAS'S HOSPITAL.

Operation.

The only operation performed here this week was that of Lithotomy, by Mr. TYRRELL. The stone was of a circular figure, and rather larger than a hazel nut. The operation occupied about three minutes, and was conducted in a very good style. *Suum cuique* is our motto; and although we have had occasion to perform venesection on Mr. TYRRELL when he had a fit of the *cacoethes scribendi*, we have not the least hesitation to give him the full credit for what, during his *convalescence*, he may do well. We only advise him to avoid a *relapse*.[1]

[1] Editorial observations.

THE CHEMISTRY OF THE OYSTER AND SOME REMARKS WITH REGARD TO ITS DIETETIC VALUE.

THE public confidence has been shaken once more in regard to the innocent nature of the oyster by the occurrence of an outbreak of typhoid fever in Hampshire amongst persons who partook of a banquet at which oysters were a feature of the repast. It was hoped that since the issue of several Local Government Board reports considerable changes had been made in the sewerage systems to the defects of which the specific pollution of oyster beds had clearly been traced. Although undoubtedly satisfactory precautions have been taken with regard to the more important oyster beds of this country, such as those at Whitstable and in the river Colne, it would appear that there still remain small local beds on certain parts of our coast in connexion with which little or no effort has been made to prevent the contamination of oysters by sewage. The outbreak of typhoid fever at Portsmouth, Winchester, and Southampton once again illustrates the importance of establishing a rigid system of control over every oyster bed in the country with a view to the prevention of the pollution of the waters in which the oysters are bred and grown. There is no doubt that the oyster is generally regarded as a delicacy and a dainty morsel, whatever may be said as to its real worth as an article of nutriment. Further, it is usually agreed that the oyster is of a highly digestible character—an opinion which has doubtless had a large share in making oysters a very popular article of food. Few can regard the oyster as an essential factor of a daily dietary. It is rather a delicacy and, like all real delicacies, it commands a high price. From a strictly chemical point of view the high-class "native" is, of course, not worth the money that is usually paid for it, but the same may be said of high-class wines which though infinitely superior to the cultivated palate yet present a chemical composition much in common with cheap or ordinary wines. The question naturally arises whether, in view of the risk which has been shown occasionally to exist in eating an oyster poisoned with sewage it ought to be banished, to be absolutely safe, from even the category of special or delicate foods. On account of their great digestibility and light character and appetising flavour oysters are commonly recommended to the fastidious invalid. It has been said that the oyster digests itself and this is probably true when we consider that the edible part consists almost exclusively of liver. Thus Dujardin-Beaumetz has asserted that when the liver is crushed the hepatic cells are set free and the glycogen is brought into contact with the hepatic ferment so that a veritable auto-digestion of the liver takes place and the oyster therefore makes but little demand on the functions of the stomach of the partaker. According to this view the oyster should form a valuable, because an easily assimilable, food for the invalid and especially for those suffering from an irritable state of the digestive organs.

The literature concerning the composition of the oyster is rather scanty and that which exists is somewhat widely scattered, the subject also being generally approached in a not very practical manner. We have therefore considered it of interest to place before our readers the results of an investigation undertaken in THE LANCET Laboratory bearing mainly upon the chemical composition of the oyster, and we venture to think that apart altogether from the point of view of the exquisite flavour and delicacy of the oyster the results throw light upon its nutritive value and bring forward some points of dietetic significance. The oysters examined belonged to the "native" class throughout, the results having no reference to the big, deep-sea oyster. First of all may be presented the broad results of analyses—that is to say, results which have reference only to the percentage amount of moisture, organic matter, and mineral

matter in the oyster—while the average weights of the entire oysters sold at three different prices are appended :—

Proximate Analysis of Various Oysters.

	Oysters at 3s. 6d. per dozen.		Oysters at 2s. 6d. per dozen.		Oysters at 1s. per dozen.
Moisture*	77·00	.....	79·80	.....	82·90
Organic matter	21·40	.....	17·76	.....	14·79
Mineral matter	1·60	.....	2·44	.....	2·31
Totals	100·00	.....	100·00	.....	100·00
Average weight of oyster in grains	157·61	.....	133·00	.....	135·00

* Exclusive of liquid in the shell, which averaged in each oyster two cubic centimetres or 34 minims (about half a teaspoonful).

It will be seen from these results that the most expensive oyster contains the highest proportion of solid matter and is the heaviest oyster. The cheapest oyster contains the least amount of solid matter, whilst its weight is considerably less than that of the expensive oyster. The oyster intermediate in price comes between the two as regards the amount of solid material. These results are interesting in connexion with the attempts "to fatten" the oyster. As a matter of fact, the increase in plumpness of the oyster is due to the imbibition of moisture. To a certain extent, also, apart altogether from the question of delicacy of flavour, the prices bear some ratio to the actual amount of dry nutritive material contained in the oyster.

The organic portion of the oyster was next submitted to analysis. As will be seen, the analysis included the determination of the nitrogenous constituents, glycogen, fat, and nitrogen-free substances. The results were as follows:—

Percentage Composition of the Organic Matter of the Oyster.

	Oysters at 3s. 6d. per dozen.		Oysters at 2s. 6d. per dozen.
Proteid, albumins, &c.	43·50	.....	49·27*
Glycogen	2·80	.....	5·13
Fat	4·30	.....	5·18
Non-nitrogenous matters ...	49·40	.....	40·42
	100·00		100·00

* Containing albumins coagulated on heating 13·62 per cent.—that is, about one-third of the total nitrogenous matter.

On account of the glycogen in oysters the mollusc has been regarded as unsuitable for diabetic patients. According to our analyses, however, the amount of liver sugar in the oysters which we examined was very small and certainly considerably less than half that found by previous observers. We made, however, a number of experiments on this point and in no instance did the amount of glycogen in the raw oyster exceed 1 per cent. A further examination of the organic portion of the oyster revealed the presence of glycero-phosphoric compounds, which are now used in medicine in the form of lecithine and of the glycero-phosphates of the alkaline metals for the purpose of improving the general nutrition of the nervous system. Again, the flesh of the oyster gave very definite reactions corresponding with those yielded by well-defined biliary principles.

We next turn to the composition of the mineral portion of the oyster. As a mean of several analyses the following results were gained :—

Percentage Composition of the Mineral Matter of the Oyster.

Copper (as oxide)	0·125
Sodium chloride	32·000
Calcium phosphate	11·250
Magnesium phosphate	7·000
Soluble phosphates	49·625
	100·000

A consideration of the entire results shows that not only does the oyster contain all classes of nutritive material, such as proteid, carbohydrate, fat, and mineral matter, but also for the most part that these are present in a readily assimilable form. This applies particularly to the coagulable albumins, to the glycogen, to the organic phosphorus compounds, and to those substances which, as in beef tea, develop the so-called osmazome on heating or cooking.

The next results refer to the solubility of the oyster is various liquids, including water, wine, and beer :—

Solubility of the Oyster in Various Liquids.

	Percentage of raw oyster dissolved.		Percentage of dry matter dissolved.
Cold water (oyster crushed)	7·47 to 10·75	.....	37·35 to 53·75
Cold water (oyster uncrushed)	4·89	.....	24·45
Stout	*nil.*	.....	*nil.*
Chablis	7·54	.....	37·77*
Diluted gin (1 part gin, 4 parts water)	8·50	.....	42·50

* These extractives contained the entire mineral matter of the oyster owing to the solvent action of the acids of the wine on the phosphates.

According to these results the best solvent of the oyster next to cold water is diluted gin. This is a somewhat interesting result in view of the preference which some people give to gin as an accompaniment of a repast of oysters. It is probable that diluted gin in being a decided solvent of the oyster develops or brings out its flavour considerably. Still more interesting are the differences shown when the crushed oyster and the uncrushed oyster respectively are acted upon by cold water. No less than one-half of the solid matter of the oyster is soluble in water if the oyster is first crushed. On the contrary, when the oyster is not crushed only one-fourth of the solid contents is dissolved by cold water. Certainly the true flavour of an oyster is appreciated most when the mollusc is deliberately masticated and not when it is swallowed whole. Opinions, however, differ on this point, but this experiment as regards the solubility of an oyster shows that mastication means the dissolution of at least, and probably more than, half of the oyster in the mouth. Chablis is also a good solvent of the oyster and particularly of the mineral matters; indeed, the whole of the phosphates are dissolved by chablis. Champagne being a similarly delicately acid wine would probably prove a solvent of equal power, with the added advantage that the effervescing liquid would further favourably influence gastric digestion. Stout is preferred by many persons as a beverage with oysters, but curiously enough stout appears to have no solvent effect upon the oyster, probably because the stout already contains a relatively large proportion of soluble matter. It may be added that when the cold water extract of a crushed oyster is heated an albuminous coagulum is formed and on concentrating the watery extract a brown liquid results which is indistinguishable as regards taste and smell from well-prepared beef-tea. It develops osmazome to a remarkable degree. The boiled oyster yields scarcely any soluble matter to cold water, and it becomes tough and indigestible by the process. The clear liquor in which the oyster is boiled contains certain extractives, but of course not the coagulable proteids.

In some quarters considerable importance has been attached to the liquor contained in the oyster shell. We found that on analysis this liquor gave the following results :—

Analysis of the Liquor of the Oyster.

	Per cent.
Water	95·41
Organic matter	0·90
Sodium chloride with traces of phosphate and iodide of sodium	3·69
	100·00

The liquid was opalescent and gave a slight coagulum on boiling but did not contain sugars or reducing substances. According to these results the liquor cannot be regarded as possessing any special nutritive value, consisting chiefly of common salt.

CONCLUSIONS.

The results on the whole show that although the actual amount of nutritive material in a raw oyster is small, yet this material comprises all classes of food substances—namely, proteid, carbohydrate, fat, and certain mineral salts. Moreover, the flesh of the oyster undoubtedly contains these substances in a peculiarly assimilable form. We have already referred to some of these, such as albumins and organic phosphorus compounds. When considering the actual nutritive value of the oyster regard must of course be paid to the fact that, generally speaking, four-fifths of

the raw mollusc consist of water. The same is very nearly true for beef and mutton (which, it must be remembered, are in a number of cases far less appetising than is the oyster), the former containing 75 per cent. of water and the latter a little less in moderately-fat portions. As far as our experiments have gone there are no important chemical or dietetic differences between the cheap and the expensive oysters. Speaking of "natives," the former as a rule weighs less and contains more water than does the latter. Copper is apparently a constituent common to all oysters in minute amount. It probably occurs in an organic compound much in the same way and form as iron occurs in the hæmoglobin of the blood. Apart from the extreme delicacy of the oyster and from its peculiarly appetising flavour, there are, we think, reasons, on purely dietetic grounds, why attention should continue to be given to the cultivation of the oyster which, as the foregoing results indicate, is an excellent article of food. This being so, it is all the more desirable that the oyster should be placed under very special sanitary provisions in regard to its environment, whether it be in the bed or in the keg.

VITAL STATISTICS.

HEALTH OF ENGLISH TOWNS.

In 76 of the largest English towns 8174 births and 5582 deaths were registered during the week ending Dec. 20th. The annual rate of mortality in these towns, which had been 19·1, 17·2, and 19·6 per 1000 in the three preceding weeks, was again 19·6 per 1000 during the week under notice. In London the death-rate was 19·6 per 1000, which also corresponded with the average rate in the 75 other large towns. The lowest death-rates in these towns were 6·5 in Wallasey, 10·6 in Leyton, 11·6 in Barrow-in-Furness, 12·3 in Burton-on-Trent, 12·6 in Aston Manor, 13·3 in Leicester, 13·4 in Reading and in Bury, and 13·5 in East Ham; the highest rates were 24·9 in Stockport, 25·1 in Brighton, 25·4 in Wigan, 26·1 in Rochdale, 26·4 in Liverpool, 26·8 in Salford, 27·1 in Halifax, and 28·0 in Newport (Mon). The 5582 deaths in these towns included 620 which were referred to the principal infectious diseases, against 530, 563, and 593 in the three preceding weeks; of these 620 deaths, 223 resulted from measles, 100 from diphtheria, 98 from whooping-cough, 72 from scarlet fever, 67 from diarrhœa, 54 from "fever" (principally enteric), and six from small-pox. No death from any of these diseases was registered during the week ending Dec. 20th in Hornsey, Bournemouth, Ipswich, Handsworth, Wallasey, Bury, St. Helens, or Barrow-in-Furness; while the highest death-rates from these principal infectious diseases occurred in Great Yarmouth, Norwich, West Bromwich, Liverpool, Salford, Hull, Tynemouth, Newport (Mon.), and Cardiff. The greatest proportional mortality from measles was recorded in West Bromwich, Smethwick, Liverpool, Salford, Hull, Middlesbrough, South Shields, Tynemouth, and Newport (Mon.); from scarlet fever in Great Yarmouth, Wigan, and Burnley; from diphtheria in Reading, Bristol, Salford, Hull, Cardiff, Rhondda, and Swansea; from whooping-cough in Southampton, Great Yarmouth, Norwich, Stockport, and Cardiff; from "fever" in Merthyr Tydfil; and from diarrhœa in Warrington and Middlesbrough. The six fatal cases of small-pox registered in these towns during the week under notice included two in Bolton and one each in Hanley, Oldham, Blackburn, and Rotherham. The number of small-pox patients under treatment in the Metropolitan Asylums hospitals on Saturday, Dec. 20th, was 21, against 17 on each of the three preceding Saturdays; five new cases were admitted during the week, against four, six, and one in the three preceding weeks. The number of scarlet fever cases in these hospitals and in the London Fever Hospital, which had declined from 2900 to 2565 at the end of the six preceding weeks, had further decreased to 2487 on Dec. 20th; 279 new cases were admitted during the week ending on that date, against 362, 265, and 250 in the three preceding weeks. The deaths referred to diseases of the respiratory organs in London, which had been 426, 370, and 399 in the three preceding weeks, further rose to 409 in the week under notice, but were 30 below the corrected average number. The number of deaths in London directly attributed to influenza was 37, against 13, 13, and 21 in the three preceding weeks. The causes of 74, or 1·3 per cent., of the deaths in the 76 large towns were not certified either by a registered medical practitioner or by a coroner. All the causes of death were duly certified in West Ham, Bristol, Nottingham, Salford, Bradford, Leeds, and in 42 other smaller towns; the largest proportions of uncertified deaths were registered in Willesden, Smethwick, Liverpool, Preston, Sheffield, and Sunderland.

HEALTH OF SCOTCH TOWNS.

The annual rate of mortality in eight of the principal Scotch towns, which had been 20·0, 18·5, and 19·9 per 1000 in the three preceding weeks, further rose to 21·1 per 1000 during the week ending Dec. 20th, and was 1·5 per 1000 above the mean rate during the same period in the 76 large English towns. Among these Scotch towns the death-rates ranged from 15·6 in Leith to 22·1 in Aberdeen and 24·4 in Dundee. The 681 deaths in these towns included 32 which were referred to whooping-cough, 15 to diarrhœa, six to scarlet fever, six to "fever," five to measles, and four to diphtheria, but not one to small-pox. In all, 68 deaths resulted from these principal infectious diseases during the week under notice, against 58, 64, and 72 in the three preceding weeks. These 68 deaths were equal to an annual rate of 2·1 per 1000, which was slightly below the mean rate from the same diseases in the 76 large English towns. The fatal cases of whooping-cough, which had been 15, 16, and 31 in the three preceding weeks, further rose to 32 during the week ending Dec. 20th, and included 22 in Glasgow, three in Edinburgh, two in Dundee, two in Aberdeen, and two in Greenock. The deaths from diarrhœa, which had been 18 and 20 in the two preceding weeks, declined again to 15, of which six were registered in Aberdeen, five in Glasgow, and two in Edinburgh. The fatal cases of scarlet fever, which had been 10 and two in the two preceding weeks, rose again to six during the week under notice, and included two in Glasgow. The deaths referred to different forms of "fever," which had been seven and three in the two preceding weeks, increased again to six, of which four occurred in Glasgow. The fatal cases of measles, which had been four and seven in the two preceding weeks, declined again to five and included two in Glasgow, where two of the four deaths from diphtheria also were registered. The 170 deaths referred to diseases of the respiratory organs in these towns showed a considerable excess over the numbers in recent weeks, but were slightly below the number in the corresponding period of last year. The causes of 24, or nearly 4 per cent., of the deaths registered in these eight towns during the week ending Dec. 20th were not certified.

HEALTH OF DUBLIN.

The death-rate in Dublin, which had been 30·5, 25·9, and 29·2 per 1000 in the three preceding weeks, further rose to 30·8 per 1000 during the week ending Dec. 20th. During these four weeks the death-rate has averaged 29·1 per 1000, the rates during the same period being 18·8 in London and 19·3 in Edinburgh. The 224 deaths of persons belonging to Dublin registered during the week under notice showed an increase of 12 upon the number in the preceding week, and included 20 which were referred to the principal infectious diseases, against 35, 16, and 22 in the three preceding weeks; of these nine resulted from measles, four from "fever," three from whooping cough, three from diarrhœa, and one from scarlet fever, but not one from either small-pox or diphtheria. These 20 deaths were equal to an annual rate of 2·8 per 1000, the death-rates from the same diseases being 1·9 in London and 1·1 in Edinburgh. The fatal cases of measles, which had been nine and 10 in the two preceding weeks, declined again to nine during the week ending Dec. 20th. The deaths from "fever" and those from diarrhœa showed a slight decline from those recorded in the preceding weeks. The fatal cases of whooping-cough numbered three, none having been registered in any of the four preceding weeks. The 224 deaths in Dublin during the week under notice included 43 of children under one year of age and 66 of persons aged 60 years and upwards; the deaths of infants showed a slight decline, while those of elderly persons considerably exceeded the number in the preceding week. Nine inquest cases and five deaths from violence were registered; and 71, or nearly one-third, of the deaths occurred in public institutions. The causes of 10, or more than 4 per cent., of the deaths were not certified.

THE SERVICES.

ROYAL NAVY MEDICAL SERVICE.

Frederick Francis Mahon has been reinstated on the list of Surgeons in His Majesty's Fleet, with seniority of July 11th, 1898, in accordance with His Majesty's Order in Council of Dec. 16th, 1902.

ROYAL ARMY MEDICAL CORPS.

Captain C. J. O'Gorman, D.S.O., is seconded for service with the South African Constabulary. Dated Sept. 5th, 1902.

IMPERIAL YEOMANRY.

Suffolk (the Duke of York's Own Loyal Suffolk Hussars): The following announcement is substituted for that which appeared in the *London Gazette* dated Nov. 7th, 1902:—Surgeon-Lieutenant-Colonel A. Cooper resigns his commission and is granted the honorary rank of Surgeon-Colonel, with permission to wear the uniform of the regiment on retirement. Dated Nov. 8th, 1902. Leonard Avery Avery to be Surgeon-Lieutenant. Dated Dec. 24th, 1902.

VOLUNTEER CORPS.

Rifle: 5th (the Hay Tor) Volunteer Battalion the Devonshire Regiment: Surgeon-Major W. H. Webb to be Surgeon-Lieutenant-Colonel. Dated Dec. 24th, 1902. 4th Volunteer Battalion the Sherwood Foresters (Nottinghamshire and Derbyshire Regiment): The undermentioned officer ceases to be seconded and is borne as Supernumerary whilst serving with the Sherwood Foresters Volunteer Infantry Brigade:—Surgeon-Lieutenant-Colonel F. H. Appleby. Dated Dec. 24th, 1902. 3rd Volunteer Battalion the South Staffordshire Regiment: Surgeon-Lieutenant F. Edge to be Surgeon-Captain. Dated Dec. 24th, 1902.

THE ARMY MEDICAL SERVICE.

At the examination in hygiene and pathology at the end of the junior course at the Medical Staff College which terminated on Sept. 30th last the following Lieutenants on probation gained prizes:—Herbert prize and Parkes memorial bronze medal (first in hygiene), Lieutenant A. B. Smallman; Lieutenant W. F. Tyndale, the prize in Pathology; Lieutenant W. B. B. Taylor, the De Chaumont prize (second in hygiene); and Lieutenant J. McKenzie, the Marshall Webb prize.

NOTES FROM INDIA.

(FROM OUR SPECIAL CORRESPONDENT.)

The Inoculation Mishap.—Decreasing Famine.

THE inoculation mishap in the Punjab is still without explanation, although the local government has submitted a communication to the press. It appears that after the middle of September the anticipated supply of serum was not forthcoming and that a change had been made in the method of its preparation. Notwithstanding difficulties on this score no less than 120,000 people were voluntarily inoculated during the month of October. It soon became apparent that the fluid supplied was not entirely free from contamination and some of it had to be rejected. A few cases of death occurred, apparently from its use. Then came the disaster at Mulkowal where 19 persons were found suffering from tetanus and died. The Government has determined to compensate the families liberally. All inoculation was then stopped. Inquiries at Bombay were made to find out whether the fault lay in the new method of manufacture or in some accidental contamination. The Government note would attempt to divide the blame, but it is obvious that if the deaths were due to tetanus contamination must have occurred. The original method has been fallen back upon and the old serum is now being prepared. It is estimated that 10,000 doses per diem will be available from Dec. 5th. On the other hand, I hear that inoculation for plague with the new modified serum has been carried on in the Mysore province for some months and that its protective value has been popularly recognised.

The decrease of the famine has been very rapid during the past few weeks and on Nov. 25th only 29,945 persons were receiving relief—3876 on relief works and 26,069 gratuitously. Bombay and Sind continue to be the chief sufferers.

Dec. 4th.

Inoculation for the Delhi Durbar.—The Plague Epidemic.—New Sanitary Regulations for Bombay City.

It is very satisfactory to find that the Maharajah of Alwah, the Alwah Imperial Service Troops, and the whole of His Highness's *entourage* have been inoculated against plague prior to proceeding to Delhi. This is an example which might well be copied as the followers of many of these chiefs will have come from infected parts and might be the means of spreading plague rapidly amongst the greatly crowded quarters. The disease being already in Delhi an outbreak may reasonably be expected soon after the Durbar.

The plague mortality throughout India continues to mount up. For the week ending Dec. 6th, 12,400 deaths were recorded as against 12,039 for the previous seven days and 8878 in the corresponding week of last year. The increase is chiefly in the Bombay Presidency, the United Provinces, and the Punjab, the detailed figures published being Bombay Presidency, 6182 deaths, an increase of 247; the Punjab, 1695, an increase of 283; and the United Provinces, 1263, an increase of 90; Bengal returns 865 deaths, with a decided increase for Calcutta; Bombay city returns 180 deaths; and Karachi, 15. The number of deaths recorded is less for the Madras Presidency, 312 against 344; for the Mysore State, 912 deaths, against 1042; for the Hyderabad State, 731, against 790; and for Berar, 247, against 295. In these latter districts plague may be said partially to have worked itself out. The increase during the past fortnight in the Saran, Monghyr, Patna, Darbhanga, and Shahabad districts of Bengal is very marked.

Severe criticism has recently been passed upon some of the new sanitary regulations adopted by the municipality of Bombay. They are considered to be indiscriminately severe. The objections are chiefly against certain constructive requirements for closets. It is directed that there shall be a space open to the sky three feet wide on each of the three sides and that the fourth or communicating side must be a passage four feet in width open at either end. This is obviously directed against the present terribly insanitary state of the privies in the native quarters and for these houses is not a bit too exacting. It is, however, questionable whether such an arrangement is necessary for European houses. The British conditions of one external wall with a window and other means of ventilation would surely be sufficient, at any rate where all the sanitary appliances are of the most approved type. Another grievance is in the requirement of a window three feet by three feet. This, again, is undoubtedly desirable for native privies, but exceeds British regulations. If these new conditions are peremptorily imposed upon European houses which fulfil European conditions a real grievance will exist unless it can be shown that an Indian climate demands more complete sanitary ventilation even where the British standard prevails. Those who know the native houses of Bombay will realise that nothing less than isolating the closets from the building will prove of any ultimate benefit and the new regulations provide for this so far as is possible. It is necessary to take into consideration the habits of the people as well as the structures to be used. On the whole, the new regulations are in the right direction and if applied at once to native buildings should also, as conditions require it, be applied to European houses. The Calcutta standard is too low, as it allows a water-closet to be placed almost anywhere (except under a dwelling room) and a hand-served privy within four feet of the walls, and the regulations are very defective as regards approaches, size, and ventilation.

Dec. 13th.

PARIS.

(FROM OUR OWN CORRESPONDENT.)

Microbes in Operating Theatres and in Hospitals.

AT the meeting of the Society of Surgery held on Dec. 10th M. Quénu communicated the results of some most interesting researches which he had made in collaboration with M. Lauvel upon the microbes present in the atmosphere of operating theatres and hospitals. The two

observers had made numerous experiments in operating theatres, in wards assigned to septic cases, in wards assigned to cases probably septic (*demi-septiques*), and in those assigned to aseptic cases. In operating theatres the number of germs in the air increased in direct proportion to the number of assistants present. As a rule the number of germs bears a direct relation to the state of the air, whether it be calm or disturbed, a fact which explains why it is that in the septic wards where the patients are confined to bed the air contained less germs as shown by Petri cultivations than in the wards assigned to aseptic cases where the patients are up and about. M. Quénu considers that it is wrong to say that the state of the air in an operating theatre has no influence and he thinks that in preparing a room for an operation the condition of the air should be thought of as well as that of the floor or the walls. To destroy the germs the two observers tried various means. A spray of pure water brought down the proportion of germs by one-half, a carbolic acid spray by two-thirds, and a corrosive sublimate spray by three-quarters. Chloroformol or oxygenated water sprays rendered the atmosphere germ-free. Chloroformol, however, cannot be used in practice for it renders the air irrespirable for many days, but oxygenated water gives as good a result. It acts like fresh air and sunshine and the purifying effect remains for some days. Sprays of this material are obviously indicated for the disinfection of operating theatres.

The Diagnosis of Leprosy.

M. Leredde and M. Pautrier, working on the lines laid down by M. Jeanselme who has demonstrated the importance of examining the nasal mucus as a diagnostic point in some cases of leprosy, have undertaken some researches for the purpose of ascertaining whether it might not be possible to bring about the appearance of Hansen's bacillus in cases of leprosy or of suspected leprosy where the bacillus did not seem to be present. Their method is very simple. They gave to two patients in whom the existence of leprosy was doubtful four grammes of potassium iodide in the day. This drug has the power of setting up a nasal catarrh with hypersecretion of mucus. On the day following that on which the iodide had been given M. Leredde and M. Pautrier were able in the nasal secretion from both patients to determine the existence of the bacillus, although before giving the iodide it had been sought for in vain. They read an account of their researches at the meeting of the Society of Biology which was held on Dec. 5th. They allowed that the method did not always meet with success, for sometimes the iodide produced no catarrh, and they quoted a case under their own care in which this happened. One failure, however, should not discourage the observer and the test can be repeated over and over again if an interval of some days is allowed to elapse between the days on which the drug is given. They consider that the method is capable of rendering great service in diagnosis, but it must be remembered that although finding the bacillus is an absolute confirmation that the disease is leprosy, yet the failure to find it does not necessarily mean that the disease is not leprosy.

Dec. 30th.

ROME.

(FROM OUR OWN CORRESPONDENT.)

Endovenous Medication.

THE method of endovenous medication, originally practised by Professor Baccelli for introducing quinine quickly and with certainty into the system, has not extended its range of application so rapidly as might have been expected considering the success which from the first has attended its use in malaria, and especially in the deadly pernicious forms of that disease. Professor Mariani of Genoa, in a paper read before the Twelfth Congress of Internal Medicine held at Rome recently and presided over by Professor Baccelli himself, has taken up the subject with much enthusiasm, convinced that the method is highly scientific and that it is destined to be regarded in the future as one of the greatest triumphs of its originator and as "one of the glories of Italy." He and Dr. Canalis, experimenting with rabbits and using doses of from a quarter to one-tenth of a milligramme of bichloride of mercury per kilogramme of body weight, did not succeed in saving any animals infected with septicæmia by means of endovenous injection, but by using the blood serum of rabbits which had been subjected to endovenous injections of the sublimate they found that some animals infected with streptococcic septicæmia could be saved. By a further series of experiments it was proved that the action of this serum was antitoxic, not bactericidal, and from these and other experiments with toxic doses of tuberculous protein they concluded that the endovenous injections of corrosive sublimate act by exciting the powers of the organism in the production of antitoxin. Professor Mariani next studied the chemical effects of different strengths of corrosive sublimate solution on the serum of the blood. On adding five cubic centimetres of a solution of 1 in 1000 of sublimate to an equal quantity of serum there was no precipitation, but with a solution of 5 in 1000 a precipitate appeared, which, however, dissolved in an excess of serum and was found to consist not of albuminate of mercury but of albumin. He therefore concluded that with endovenous injections of solutions of 1 in 1000 of corrosive sublimate no precipitate is produced; that solutions more concentrated may cause a precipitate, which, however, immediately re-dissolves in an excess of serum; that albuminate of mercury is never formed; and that the bichloride passes into the blood current as such and is not transformed into any other compound of mercury. As to injurious effects on the veins from endovenous injections he found that these do not occur if the proper technique be used, if a good-sized vein be selected for the injection, and the latter be made with sufficient slowness so as to give the fluid time to mix with the blood. He noticed no histological changes in the blood itself following upon injections of the sublimate in therapeutic doses. The curative effects of such injections in epizoötic aphtha were, he thought, best demonstrated by the statistics which he had collected from 62 reports of veterinary surgeons, which showed in 2308 cases so treated 100 per cent. of recoveries. In regard to the injection of other drugs he referred to the successes obtained in malaria with quinine and in anæmia with the citrate of iron and ammonia and recounted the results of his own experiments on man and animals with various medicinal substances. Some of these—namely, ergotin, creasote, and chloral—proved rapidly fatal to animals and were not tried in man, but a number of others, including Fowler's solution of arsenic, benzoate of soda, benzoate of lithia, tincture of iodine, antipyrin, nitrate of silver, alcohol, and gelatin, were well tolerated and proved beneficial in certain diseases in the human subject. For example, an endovenous injection of 130 cubic centimetres of gelatin stopped instantaneously a copious hæmoptysis in a tuberculous patient. But the most interesting of the experiments described by Professor Mariani were those with oxygen, which gas he has been the first to employ clinically in this manner. Having found that five litres of oxygen could be injected into the veins of a dog without producing emboli and without proving fatal, he introduced by means of a special apparatus for measuring the quantity of gas 120 cubic centimetres of oxygen into the veins of a young man suffering from pulmonary tuberculosis, who on account of a rapid extension of the process had developed symptoms of asphyxia and appeared to be *in extremis*. The improvement was immediate and marked, the respirations falling by 14 and the pulse by 21 per minute. Oxygen thus injected into the veins is completely absorbed by the red blood corpuscles and does not give rise to gaseous emboli if injected slowly in such a way as to introduce not more than 500 cubic centimetres in one hour. Professor Mariani believes that such injections will prove of immense value in cases where the oxidation processes are imperfect by stimulating the production of oxyhæmoglobin. He observed also that they improved the cardiac rhythm and raised the endo-arterial tension when not performed too rapidly.

Dec. 29th.

EGYPT.

(FROM OUR OWN CORRESPONDENT.)

The Medical Congress.

OWING to a number of unfortunate circumstances there are only two delegates from Great Britain to the Congress. The Royal College of Surgeons of England is

ably represented by Mr. Reginald Harrison who has devoted nearly every day of his stay in Cairo to making a detailed inspection of Kasr el Ainy Hospital and the school of medicine attached to it. Mr. W. D. Spanton represents the British Medical Association, but the Royal College of Physicians of London, the Medico-Psychological Association, the Neurological Society, the Durham Medical Graduates' Association, and the Universities of Melbourne, Sydney, and Adelaide all have to be represented by practitioners resident in Cairo. The United States have sent three official delegates and all the other great powers, except Spain, are well represented. A preliminary evening reception was held at the Continental Hotel on Dec. 18th, where the numerous guests had an opportunity of becoming acquainted with one another. On the morning of Dec. 19th the Congress was officially opened by His Highness the Khedive, surrounded by all his Ministers, in the Opera House. The house was brilliantly lighted by electricity, was filled with invited guests, and presented a very gay appearance. The members of the various committees and the foreign delegates occupied the large stage, while the floor of the theatre was reserved for members of the Congress and guests. The lower boxes were occupied by the Royal Family, the various diplomatic agents, and other high officials. Another row of boxes contained officials and the wives of foreign members. The wives of residential members occupied the upper boxes and the gallery above them was crowded with medical students. The Khedive read a short speech of welcome in French and was followed by Ibrahim Pasha Hassan, the President of the Congress, who, though a polyglot, preferred to speak in Arabic. Dr. Abbate Pasha, the *doyen* of the medical corps in Egypt, who served at Balaklava with the Egyptian navy and proudly wears the English Crimean medal, reminded the audience that about 2000 years ago Ptolemy Soter assembled in Alexandria all the leading physicians and astronomers of the world and from that congress sprang the historic museum and the famous school of medicine in Alexandria. Dr. Voronoff, the Russian secretary-general, then stated that the Congress already numbered 500 members, consisting of 150 Egyptians, 190 Europeans resident in Egypt, and 160 visitors. Also that 246 papers had been announced for the three sections of medicine, surgery, and ophthalmology. Then followed short complimentary addresses from Dr. Nolda for Germany, Professor Nothnagel for Austria, Dr. Eid for Belgium, Major Gorgas for America (who brought congratulations from the youngest civilised country to the oldest), Professor Bouchard for France, Mr. Reginald Harrison for Great Britain and Ireland, Professor Karl Hoor for Hungary, Professor Maragliano for Italy, Mirza Muhamad Khan for Persia, Professor Pawloff for Russia, and Professor Eternod for Switzerland. Lastly came an address chiefly on therapeutics from Professor Bouchard. Later in the day the Khedive received about 100 foreign guests in two groups at his palace and in the evening there was a moonlight *fête* at the Pyramids, enlivened by Bedouin dances and mounted frolics and an English cavalry band. On the following day the serious work of the sections began at the medical school.

Cairo, Dec. 22nd.

NEW YORK.

(FROM OUR OWN CORRESPONDENT.)

Experiments to note the Effects of Pure and Adulterated Foods.

PROFESSOR WILEY, chief chemist of the United States Department of Agriculture, is carrying on a very interesting and important series of experiments with foods, the subjects of the experiments being 12 young men selected from the staff of the department. It is believed that the experiments will not only prove of the greatest benefit and advantage to the public, but that the data gained by the department relative to the various deleterious substances in common use in foodstuffs in this country will form the basis of the "Pure Food Bill" which the secretary will present to Congress. The young men will not eat any "poisoned" or adulterated food for about two weeks or until Professor Wiley finds out all about their physical peculiarities and determines just how much wholesome food it takes to keep each one at a certain weight. They were weighed and then had a breakfast prepared by the department's cook. Every ounce of food put before them had been carefully weighed and measured and every drop of water given them to drink had been filtered and rendered germ free. Every morning they will be weighed, their pulse taken, and the results noted on a big chart, and in the course of two weeks Professor Wiley expects to be able to tell to a fraction just how much wholesome, substantial food is necessary to keep each of them at the exact figure at which he weighed on the first day. When this has been accomplished the 12 men will be divided into two squads and will take their meals at separate tables, at one of which pure food will be served and at the other food which has been "poisoned" or adulterated by means of preservatives and colouring matter which are in general use in all classes of foods sold on the American Market. The squad will be kept on their adulterated diet long enough to enable Professor Wiley to observe whatever effect it may have upon them. They will then have a rest of 15 days, during which time they will again eat nothing but pure food, while the other squad will take its place at the "poison" table. By alternating the two squads and comparing the results of the observations made while the members of the experiment table are on a pure food diet, with the observations of their respective physical conditions when eating food mixed with supposedly poisonous substances, it is expected that it will be possible to determine just how deleterious to the human system the various adulterants, preservatives, and colouring matters are.

Death of Major Walter Reed.

In the death of Major Reed the United States army has lost one of its most distinguished medical officers and bacteriological science a most devoted student. Major Reed died from appendicitis following an operation in a hospital at Washington. Soon after his graduation he became identified with the Army Medical Museum in which he organised and developed the pathological and bacteriological laboratories which are now important departments of the Army Medical School. Major Reed's reputation will rest permanently upon two features of his work. The first is his experimental study into the causes of the hepatic lesions in typhoid fever which now forms a part of the permanent literature of that disease. The second is his investigation of the part which the mosquito plays in the spread of yellow fever and the practical application of the knowledge thus obtained in Cuba. The work in the latter field taxed his energies to the utmost and is believed to have contributed to his want of resisting power when the stress and strain of his disease were upon him.

The American Public Health Association.

This large and influential body recently held its annual session at New Orleans. It now comprises delegates from Mexico and Canada. One of the burning questions was quarantine and it is interesting to notice the progress that is being made towards an open port under strict sanitary supervision. The delegate from Havana, Cuba, Dr. Lindsley, urged that the association should commit itself to the theory that the yellow fever mosquito is the only means of communicating that pestilence and therefore the only preventive measure necessary is to see that no person infected with the fever and no infected mosquitoes are imported. If the ship is disinfected and the mosquitoes are killed and there is no fever on board there should be no detention. The discussion showed the popularity of these views, but the association did not commit itself to the principle involved that no other measures should be adopted. Dr. Walter Wyman, surgeon-general of the Public Health and Marine Hospital Service, was elected president, and the next meeting will be held at Washington.

Dec. 24th.

VACCINATION FEES.—At the meeting of the Tavistock (Devon) board of guardians held on Dec. 26th a letter was read from Mr. J. W. Spear, M.P., acknowledging the receipt of a resolution in reference to the reduction of vaccination fees. Mr. Spear stated that he agreed with the opinions expressed and added that he had seen the President of the Local Government Board and had laid the proposals before him. The President was favourable to a new scale of fees for vaccination. The chairman of the guardians, in commending Mr. Spear's action, expressed the hope that it would tend to a reduction in the fees of public vaccinators generally.

Medical News.

ROYAL COLLEGE OF SURGEONS OF ENGLAND.—The following gentlemen having passed the necessary examination and conformed to the by-laws have been admitted Fellows of the College and have received their diplomas:—

Henry Bennett Bailey, L.S.A. Lond., Member July 29th, 1870, Guy's Hospital; Herbert Wilson Pilgrim, M.B. Lond., Member Jan. 28th, 1884, St. Bartholomew's Hospital and Edinburgh University; Henry Brunton Angus, M.B., M.S. Durh., L.R.C.P. Lond., Member July 30th, 1891, Durham University; Cyril George Russ Wood, L.R.C.P. Lond., Member Feb. 11th, 1892, University College, Royal Infirmary, and General Hospital, Bristol; Vivian Tudor Greenyer, L.R.C.P. Lond., Member Feb. 9th, 1893, St. Bartholomew's Hospital; Henry Thomas Hicks, L.R.C.P. Lond., Member Nov. 12th, 1896, Guy's Hospital; James McClure, M.B., C.M. Glasg., Member July 29th, 1897, Glasgow University; James Andrew Craig, M.B., B.Ch. Ireland, L.R.C.P. Lond., Member August 2nd, 1898, Belfast and Vienna Universities; Sidney Maynard Smith, L.R.C.P. Lond., Member August 2nd, 1898, St. Mary's Hospital; Arthur Solomon Morley, L.R.C.P. Lond., Member July 27th, 1899, St. George's Hospital; Sydney Richard Scott, L.R.C.P., M.B. Lond., Member July 27th, 1899, St. Bartholomew's Hospital; Richard Warren, M.B., B.Ch. Oxon., L.R.C.P. Lond., Member Feb. 8th, 1900, London Hospital; Charles John Nepean Longridge, M.D., Ch.B. Vict., L.R.C.P. Lond., Member May 10th, 1900, St. George's Hospital; Benjamin Charles Bromhall, L.R.C.P. Lond., Member July 25th, 1900, London Hospital; Lawrence Jones, L.R.C.P., M.B. Lond., Member July 25th, 1900, St. George's Hospital; Edwyn Manners Ridge, L.R.C.P. Lond., Member July 25th, 1900, London Hospital; François Henry Wessels, M.B., B.Ch. Aberd., L.R.C.P. Lond., Member July 25th, 1900, St. Bartholomew's Hospital; Francis George Cross, L.R.C.P. Lond., Member Feb. 7th, 1901, of Guy's Hospital; Arthur Ralph Thompson, M.B., Ch.B. Vict., Member August 1st, 1901, Guy's Hospital and Yorkshire College and General Infirmary, Leeds; Norman Frederic Ticehurst, M.A., B.C. Cantab., L.R.C.P. Lond., Member May 9th, 1901, Guy's Hospital; Charles Buckingham Shuttleworth, M.D., C.M. Trinity, Toronto, L.R.C.P. Lond., Member Feb. 13th, 1902, Trinity College, Toronto, and King's College, London; George John Jenkins, M.B., C.M. Edin., L.R.C.P. Lond., Member Feb. 9th, 1902, King's College Hospital; Arthur Percy Parker, M.B., B.Ch. Oxon., not a Member, Middlesex Hospital and Oxford University; and Russell Henry Jocelyn Swan, M.B., B.S. Lond., not a Member, Guy's Hospital.

UNIVERSITY OF CAMBRIDGE.—Mr. F. G. Hopkins, Emmanuel College, has been appointed Reader in Chemical Physiology.—Mr. C. W. Mansell Moullin and Dr. R. G. Hebb have been appointed additional Examiners in Surgery and Medicine respectively.—Walsingham medals have been awarded to Mr. L. Doncaster, King's College, for his memoir on Experiments in Hybridisation, and Mr. V. J. Woolley, King's College, for his memoir on the Effect upon a Nerve of a Strong Interrupted Induced Current.—At the congregation on Dec. 18th Mr. C White, Christ's College, was admitted to the degree of M.D., Mr. J. H. Philbrick, Trinity College, to the degree of M.B., and Mr. F. A. Rose, St. John's College, to the degrees of M.B. and B.C.—At the recent examinations held at ten of the colleges for entrance scholarships and exhibitions 23 awards were made for natural science, as against 37 for mathematics and 51 for classics.

THE LATE MR. JOSEPH HARPER.—Mr. Harper died at his residence, Barnstaple, Devon, on Dec. 16th, in his sixty-fifth year. The deceased received his medical education at Middlesex Hospital and in 1861 took the qualifications of L.R.C.P. Lond., M.R.C.S. Eng., and L.S.A. Shortly afterwards he joined the late Dr. Morgan of Barnstaple as partner. Mr. Harper at the time of his death was consulting surgeon to the Barnstaple and North Devon Infirmary and to the Barnstaple Dispensary. He was also medical officer of health of the Barnstaple rural district, justice of the peace for Barnstaple, and a member of the town council, on one occasion being returned at the head of the poll, there being five other candidates. He was mayor of the town in 1874 and 1881. He took a great interest in the volunteer movement and was formerly surgeon-lieutenant-colonel of the 4th V.B. Devon Regiment. Mr. Harper was held in high esteem in Barnstaple and there was probably no person in the town or district who enjoyed a greater popularity among all classes. He was a keen sportsman, being a regular attendant at the meets of the Devon and Somerset staghounds. He was the means of bringing Neil Cream the poisoner to justice, in consequence of a blackmailing letter which he received from him. Mr. Harper leaves six sons, two of whom are members of the medical profession, one having been in partnership with him for some years. Mr. Harper will be much missed in Barnstaple, where he was associated with every effort for the welfare of the town.

SUSSEX COUNTY HOSPITAL.—A county ball in aid of the funds of this hospital, which is in debt to the amount of £10,000, will be held in the Royal Pavilion, Brighton, on Wednesday, Jan. 14th. There is a distinguished list of patrons headed by His Majesty the King. The music will be supplied by Mr. Alfred de Rothschild's private orchestra. Vouchers for the ball may be obtained of the patrons, of the committee, or of the Ball Secretary, 24A, Cleveland-gardens, Hyde-park, London, W., which may be exchanged for tickets at £1 1s. each (including champagne supper). Holders of ball tickets who are unable to use them will have the amount credited in full as a donation to the Sussex County Hospital ball fund.

THE FACULTY OF PHYSICIANS AND SURGEONS OF GLASGOW.—The annual dinner of the Faculty, which took place on Dec. 5th, was marked by a pleasing ceremony in the shape of the presentation of his portrait to Mr. A. Duncan, B.A., LL.D., the secretary to the Faculty. Dr. Duncan has held his present position for 37 years and it is well known in local circles that in all possible areas of activity he has devoted himself in an entirely unobtrusive, but highly efficient, fashion to the duties of his office. Dr. Duncan, indeed, has done much more than this, for the benefit of his experience and ability has ever been readily extended not only to the corporation but also to the individual Fellows. The respect and regard in which he is held found eloquent expression in the speeches made on the occasion of the presentation. In these allusion was necessarily made to the personal feelings of the contributors, to Dr. Duncan's efficient work as the Faculty librarian, and to the valuable history of the Faculty which is the product of Dr. Duncan's pen. The portrait was presented on behalf of the contributors by Dr. J. Lindsay Steven and was accepted for the Faculty by the President. In addition a replica was presented to Dr. Duncan's family, this portion of the ceremony being intrusted to Dr. D. C. McVail. In acknowledging the compliment paid to him, Dr. Duncan gave an interesting account of the changes which have taken place since he accepted office and spoke of the friendly spirit and goodwill existing between the Faculty and the other Scottish Colleges.

Appointments.

Successful applicants for Vacancies, Secretaries of Public Institutions, and others possessing information suitable for this column, are invited to forward it to THE LANCET *Office, directed to the Sub-Editor, not later than 9 o'clock on the Thursday morning of each week, for publication in the next number.*

BUTLER, A. G., M.B. Cantab., has been appointed Health Officer for the Port of Gladstone, Medical Officer at Gladstone, and a Health Officer for the purposes of the Health Act of 1900, in Queensland, Australia.

CHAPMAN, JOHN TAYLOR, L.R.C.P. Edin., has been appointed to be Public Vaccinator for the Metropolitan District, Victoria, Australia.

CHISHOLM, WILLIAM, M.D. Lond., M.R.C.S., has been appointed to the Medical Board, New South Wales.

COLE, F. HOBILL, M.B., Ch.B. Melb., has been appointed Examiner in Pharmacy and Materia Medica in the University of Melbourne, Victoria.

DEWDNEY, Mr., has been appointed Medical Officer for the Kingskerswell District by the Newton Abbot (Devon) Board of Guardians.

FULLERTON, ALEXANDER YOUNG, L.R.C.P. Lond., M.R.C.S., has been appointed Government Medical Officer and Vaccinator at Murrurundi, New South Wales.

GRAHAM, EDWARD ALFRED, M.B., B.Ch. Melb., has been appointed Government Medical Officer and Vaccinator at Deniliquin, New South Wales.

HAY, JOHN, M.D. Vict., has been appointed Honorary Assistant Physician to the Hospital for Consumption and Diseases of the Chest, Liverpool.

HENRY, LOUIS, M.D. Wurz. and Melb., has been appointed Honorary Assistant Physician at the Alfred Hospital, Victoria, Australia.

KELLY, ROBERT VANDELEUR, C.B., L.R.C.P. Edin., F.R.C.S. Edin., has been appointed Government Medical Officer and Vaccinator at Delegate, New South Wales.

PLOWMAN, SIDNEY, F.R.C.S. Eng., has been appointed Examiner in Pharmacy and Materia Medica in the University of Melbourne, Victoria.

READ, STANLEY J. DOCKER, M.B. Melb., has been appointed Public Vaccinator for the Northern District and Officer of Health for the Borough of Raywood, Victoria.

SHARP, H. C., M.B., B.C. Camb., has been appointed Medical Officer of the Kenwyn District of the Truro Union.

STACK, E. H. EDWARDS, M.B., B.C. Cantab., F.R.C.S. Eng., has been appointed House Surgeon to the Bristol Royal Infirmary.

WADE, R. B., M.B., Ch.M. Syd., has been appointed Honorary Assistant Surgeon to Sydney Hospital for Sick Children, New South Wales.

Vacancies.

For further information regarding each vacancy reference should be made to the advertisement (see Index).

ASTON UNION WORKHOUSE AND COTTAGE HOMES, Gravelly-hill, near Birmingham.—Resident Assistant Medical Officer. Salary £120 per annum, with apartments, rations, and washing.

BETHNAL GREEN BOARD OF GUARDIANS.—District Medical Officer.

BIRKENHEAD BOROUGH HOSPITAL.—Senior Resident Male House Surgeon. Salary £100 per annum, with board.

BOURNEMOUTH ROYAL VICTORIA HOSPITAL.—House Surgeon. Salary £100 per annum, with board and lodging.

BROMPTON HOSPITAL FOR CONSUMPTION AND DISEASES OF THE CHEST.—Resident House Physicians for six months. Honorarium £25.

CANTERBURY BOROUGH ASYLUM.—Assistant Medical Officer, unmarried. Salary £120 per annum, with apartments, board, and laundry.

CITY OF LONDON HOSPITAL FOR DISEASES OF THE CHEST, Victoria-park, E.—Physician to Out-patients. Also Second House Physician for six months. Salary at rate of £50 per annum, with board, lodging, and washing.

DEWSBURY AND DISTRICT GENERAL INFIRMARY.—House Surgeon. Salary £100 per annum, with board, residence, and washing.

GLOUCESTER GENERAL INFIRMARY AND GLOUCESTERSHIRE EYE INSTITUTION.—Senior House Surgeoncy. Salary £100 per annum, with board, residence, and washing.

JARROW-ON-TYNE PALMER MEMORIAL HOSPITAL.—House Surgeon, unmarried. Salary £120 per annum, with board and residence.

JENNER INSTITUTE OF PREVENTIVE MEDICINE.—Studentship of Research in the Department of Bacteriology.

LANCASHIRE COUNTY ASYLUM, Whittingham, Preston.—Assistant Medical Officer, unmarried. Initial salary £150, with apartments, board, washing, and attendance.

LEEDS PUBLIC DISPENSARY.—Honorary Surgeon. Also Honorary Ophthalmic Surgeon.

LIVERPOOL STANLEY HOSPITAL.—Third House Surgeon. Salary £70, with board, residence, &c.

LONDON COUNTY COUNCIL.—Medical Officer to employees residing in the Borough of Lewisham.

MANCHESTER ST. MARY'S HOSPITAL, Quay-street.—Medical Officer for six months. Salary at rate of £80 per annum, with board and residence.

NOTTINGHAM GENERAL HOSPITAL.—Assistant House Surgeon. Salary £100, with board, lodging, and washing.

ROYAL DENTAL HOSPITAL OF LONDON AND LONDON SCHOOL OF DENTAL SURGERY, Leicester-square, W.C.—Demonstrator. Honorarium £200 per annum.

ROYAL LONDON OPHTHALMIC HOSPITAL, City-road, E.C.—Senior House Surgeon. Salary £75, with board and residence.

SAMARITAN FREE HOSPITAL, Marylebone-road, N.W.—Clinical Assistants.

SHEFFIELD EAST END BRANCH OF THE CHILDREN'S HOSPITAL.—Lady House Surgeon. Salary £70 per annum, with board, lodging, and washing.

SHEFFIELD ROYAL HOSPITAL.—Junior Assistant House Surgeon, unmarried. Salary £50 per annum, with board, washing, and lodging.

SURREY DISPENSARY, Southwark, S.E.—Resident Medical Officer. Salary £140 per annum, rising to £150, with apartments, coals, gas, and attendance.

TOTTENHAM HOSPITAL, London, N.—Two Honorary Anæsthetists.

VICTORIA HOSPITAL FOR CHILDREN, Tite-street, Chelsea, S.W.—Physician to Out-patients.

WANDSWORTH AND CLAPHAM UNION INFIRMARY, St. John's hill, S.W.—Junior Assistant Medical Officer for six months. Salary at rate of £100 per annum, with board, lodging, and washing.

Births, Marriages, and Deaths.

BIRTHS.

ADDISON.—On Sunday, Dec. 21st, at Wican Croft, Northwood, Middlesex, the wife of Christopher Addison, M.D., F.R.C.S., of a daughter.

HARRIS.—At 180, Yorkshire-street, Rochdale, on Christmas Day, the wife of Robert James Harris, M.R.C.S. Eng., L.R.C.P. Lond., of a son.

MARRIAGES.

BROWN—MAY.—On Dec. 30th, at S. John's Church, Lockerley, Hants, by the Rev. J. P. May, father of the bride, assisted by the Rev. P. Cyril Brown, brother of the bridegroom, Florence Mona May to Evelyn Kempson Brown, M.R.C.S., L.R.C.P., of Cranborne, Dorset.

MATTHEWS—WEST.—On Dec. 20th, at St. Mary's Church, Wimbledon, Charles Edward Matthews, M.D. Oxon., Medical Superintendent, Fountain Hospital, Tooting, S.W., to Elizabeth Jane, second daughter of the late John West, of Danholm Lodge, Lincoln.

DEATHS.

HEATH.—On the 20th December, Richard Heath, M.D., of St. Leonards-on-Sea.

PETTIFER.—On Dec. 28th, at Calcutta, of appendicitis, Edmund Cleaver Pettifer, M.B. Lond., Calcutta Plague Staff, only son of Edmund Henry Pettifer, M.R.C.S., of 52, Sewington-green, London, N.

N.B.—A fee of 5s. is charged for the insertion of Notices of Births, Marriages, and Deaths.

Notes, Short Comments, and Answers to Correspondents.

ANTI-THYROID SERUM.

To the Editors of THE LANCET.

SIRS,—In answer to "Pat" an account of a very acute case of Graves's disease treated by Merck's anti-thyroid serum is given by Schultes in the *Münchener Medicinische Wochenschrift* of May 20th, 1902, abstracted in the *British Medical Journal* Epitome of Nov. 8th, 1902. Schultes gave such a good account of its use that I have tried the serum in two cases, but I do not presume to consider either case worth recording in full as yet. The serum is that of sheep whose thyroids had been removed and is prepared by Merck of Darmstadt. It is as yet costly, being about 15*s.* for 30 cubic centimetres. Following Schultes I administered it by the mouth in doses of seven minims three times a day. Schultes increases the dose gradually to four and a half grammes (69·30 grains). The serum certainly caused no unpleasant symptoms and is easily taken in milk, and one of my patients improved so under its use that I shall certainly try it again and I shall be glad to hear of any experiences of others.

I am Sirs, yours faithfully,

Westerham, Dec. 13th, 1902. A. MAUDE.

CONSUMPTION SANATORIUM.

To the Editors of THE LANCET.

SIRS,—I would be much obliged if any of your readers would kindly let me know of a consumption sanatorium suitable for a girl who is only able to pay 25*s.* per week.

I am, Sirs, yours faithfully,

Dec. 25th, 1902. R. L. G.

M. D. Brux.—There is nothing illegal in the procedure of the unqualified dentist, but he runs the considerable risk that all unqualified persons do when they meddle with medical practice. As the offender is not on the Register the General Medical Council cannot take cognisance of his proceedings and, so far as we can see, no one can interfere with him. Such is the state of the law.

F. B.—The question is a very large one, as all readers of THE LANCET know. The circular letter, to be of any service, should be sent only to people of the first importance, people able to give some practical effect to their views. Otherwise the publication of the replies that is promised may prove impossible.

F. A. W.—The various clinical laboratories provide graduated tubes and diluting fluids for the purpose of preparing the blood for analysis and enabling it to be sent to a distance.

Medical Diary for the ensuing Week.

OPERATIONS.

METROPOLITAN HOSPITALS.

MONDAY (5th).—London (2 P.M.), St. Bartholomew's (1.30 P.M.), St. Thomas's (3.30 P.M.), St. George's (2 P.M.), St. Mary's (2.30 P.M.), Middlesex (1.30 P.M.), Westminster (2 P.M.), Chelsea (2 P.M.), Samaritan (Gynæcological, by Physicians, 2 P.M.), Soho-square (2 P.M.), Royal Orthopædic (2 P.M.), City Orthopædic (4 P.M.), Gt. Northern Central (2.30 P.M.), West London (2.30 P.M.), London Throat (9.30 A.M.), Royal Free (2 P.M.), Guy's (1.30 P.M.).

TUESDAY (6th).—London (2 P.M.), St. Bartholomew's (1.30 P.M.), St. Thomas's (3.30 P.M.), Guy's (1.30 P.M.), Middlesex (1.30 P.M.), Westminster (2 P.M.), West London (2.30 P.M.), University College (2 P.M.), St. George's (1 P.M.), St. Mary's (1 P.M.), St. Mark's (2.30 P.M.), Cancer (2 P.M.), Metropolitan (2.30 P.M.), London Throat (9.30 A.M.), Royal Ear (3 P.M.), Samaritan (9.30 A.M. and 2.30 P.M.), Throat, Golden-square (9.30 A.M.), Soho-square (2 P.M.).

WEDNESDAY (7th).—St. Bartholomew's (1.30 P.M.), University College (2 P.M.), Royal Free (2 P.M.), Middlesex (1.30 P.M.), Charing Cross (3 P.M.), St. Thomas's (2 P.M.), London (2 P.M.), King's College (2 P.M.), St. George's (Ophthalmic, 1 P.M.), St. Mary's (2 P.M.), National Orthopædic (10 A.M.), St. Peter's (2 P.M.), Samaritan (9.30 A.M. and 2.30 P.M.), Gt. Ormond-street (9.30 A.M.), Gt. Northern Central (2.30 P.M.), Westminster (2 P.M.), Metropolitan (2.30 P.M.), London Throat (9.30 A.M.), Cancer (2 P.M.), Throat, Golden-square (9.30 A.M.), Guy's (1.30 P.M).

THURSDAY (8th).—St. Bartholomew's (1.30 P.M.), St. Thomas's (3.30 P.M.), University College (2 P.M.), Charing Cross (3 P.M.), St. George's (1 P.M.), London (2 P.M.), King's College (2 P.M.), Middlesex (1.30 P.M.), St. Mary's (2.30 P.M.), Soho-square (2 P.M.), North-West London (2 P.M.), Chelsea (2 P.M.), Gt. Northern Central (Gynæcological, 2.30 P.M.), Metropolitan (2.30 P.M.), London Throat (9.30 A.M.), St. Mark's (2 P.M.), Samaritan (9.30 A.M. and 2.30 P.M.), Throat, Golden-square (9.30 A.M.), Guy's (1.30 P.M.).

FRIDAY (9th).—London (2 P.M.), St. Bartholomew's (1.30 P.M.), St. Thomas's (3.30 P.M.), Guy's (1.30 P.M.), Middlesex (1.30 P.M.), Charing Cross (3 P.M.), St. George's (1 P.M.), King's College (2 P.M.), St. Mary's (2 P.M.), Ophthalmic (10 A.M.), Cancer (2 P.M.), Chelsea (2 P.M.), Gt. Northern Central (2.30 P.M.), West London (2.30 P.M.), London Throat (9.30 A.M.), Samaritan (9.30 A.M. and 2.30 P.M.), Throat, Golden-square (9.30 A.M.), City Orthopædic (2.30 P.M.), Soho-square (2 P.M.).

SATURDAY (10th).—Royal Free (9 A.M.), London (2 P.M.), Middlesex (1.30 P.M.), St. Thomas's (2 P.M.), University College (9.15 A.M.), Charing Cross (2 P.M.), St. George's (1 P.M.), St. Mary's (10 P.M.), Throat, Golden-square (9.30 A.M.), Guy's (1.30 P.M.).

At the Royal Eye Hospital (2 P.M.), the Royal London Ophthalmic (10 A.M.), the Royal Westminster Ophthalmic (1.30 P.M.), and the Central London Ophthalmic Hospitals operations are performed daily.

SOCIETIES.

TUESDAY (6th).—PATHOLOGICAL SOCIETY OF LONDON (20, Hanover-square, W.).—8.30 P.M. Papers:—Mr. L. Cheatle: The Repair of Bullet Wounds of the Intestines.—Dr. Shrubsall and Dr. Mullings: Tuberculosis of the Œsophagus.—Dr. F. W. Andrewes: (1) A Case of Congenital Tuberculosis; (2) Two Cases of Congenital Heart Disease.—Dr. H. M. Fletcher: Cholesteatoma of the Pineal Body.—Dr. O. Grunbaum: Membraneous Gastritis. Card Specimen: Mr. Dudgeon: Unusual Form of Emphysema in an Infant.

WEDNESDAY (7th).—OBSTETRICAL SOCIETY OF LONDON (20, Hanover-square, W.).—8 P.M. Discussion on Puerperal Insanity opened by a paper by Dr. R. Jones (Claybury) (introduced by Dr. W. S. A. Griffith) and continued by Sir J. Williams, Bart., Dr. W. L. Andriezen, Dr. G. F. Blandford, Dr. F. H. Champneys, Dr. W. S. A. Griffith, Dr. G. E. Herman, Dr. T. B. Hyslop, Dr. C. Mercier, Dr. W. D. Moore, Dr. F. W. Mott, Dr. G. H. Savage, Dr. P. Smith, Dr. S. Tuke, and Dr. R. White.

THURSDAY (8th).—HARVEIAN SOCIETY OF LONDON (Stafford Rooms, Titchborne-street, Edgware-road, W.).—8.30 P.M. Annual General Meeting. Election of Officers. President's Address. Annual Conversazione.

FRIDAY (9th).—THE INCORPORATED SOCIETY OF MEDICAL OFFICERS OF HEALTH (9, Adelphi-terrace, Strand, W.C.).—7.30 P.M. Dr. A. Hillier: The Prospect of Extinguishing Tuberculosis.

LARYNGOLOGICAL SOCIETY OF LONDON (20, Hanover-square, W.).—4.15 P.M. Annual Meeting. 5 P.M. Ordinary Meeting. Cases, Specimens, and Instruments will be shown by Mr. W. H. R. Stewart, Sir Felix Semon, Dr. Bronner, Dr. W. Williams, Dr. Lack, Mr. Lake, Dr. Tilley, Dr. B. Baron, Dr. Donelan, and others. 7.45 P.M. The Annual Dinner of the Society will take place at the Cafe Royal.

CLINICAL SOCIETY OF LONDON (20, Hanover-square, W.).—8.30 P.M. Papers:—Mr. T. H. Openshaw: The Morbid Anatomy and Treatment of Congenital Dislocation of the Hip Joint.—Dr. E. W. Goodall: A Case of Hæmorrhagic Typhoid Fever.—Dr. H. D. Rolleston: Generalised Tuberculosis with Arthritis.

LECTURES, ADDRESSES, DEMONSTRATIONS, &c.

TUESDAY (6th).—ROYAL INSTITUTION OF GREAT BRITAIN (Albemarle-street, W.).—3 P.M. Prof. H. S. Hele-Shaw: On Locomotion, on the Earth, through the Water, in the Air. (Christmas Lectures adapted for Young People.)

THURSDAY (8th).—ROYAL INSTITUTION OF GREAT BRITAIN (Albemarle-street, W.).—3 P.M. Prof. H. S. Hele-Shaw: On Locomotion, on the Earth, through the Water, in the Air. (Christmas Lectures adapted for Young People.)

CHARING CROSS HOSPITAL.—4 P.M. Dr. Mitchell Bruce: Demonstration of Medical Cases. (Post-Graduate Course.)

EDITORIAL NOTICES.

IT is most important that communications relating to the Editorial business of THE LANCET should be addressed *exclusively* "TO THE EDITORS," and not in any case to any gentleman who may be supposed to be connected with the Editorial staff. It is urgently necessary that attention be given to this notice.

It is especially requested that early intelligence of local events having a medical interest, or which it is desirable to bring under the notice of the profession, may be sent direct to this office.

Lectures, original articles, and reports should be written on one side of the paper only, AND WHEN ACCOMPANIED BY BLOCKS IT IS REQUESTED THAT THE NAME OF THE AUTHOR, AND IF POSSIBLE OF THE ARTICLE, SHOULD BE WRITTEN ON THE BLOCKS TO FACILITATE IDENTIFICATION.

Letters, whether intended for insertion or for private information, must be authenticated by the names and addresses of their writers—not necessarily for publication.

We cannot prescribe or recommend practitioners.

Local papers containing reports or news paragraphs should be marked and addressed "To the Sub-Editor."

Letters relating to the publication, sale and advertising departments of THE LANCET *should be addressed "To the Manager."*

We cannot undertake to return MSS. not used.

MANAGER'S NOTICES.

THE INDEX TO THE LANCET.

THE Index and Title-page to Vol. II. of 1902, which was completed with the issue of Dec. 27th, are given in this number of THE LANCET.

VOLUMES AND CASES.

VOLUMES for the second half of the year 1902 will be ready shortly. Bound in cloth, gilt lettered, price 18*s.*, carriage extra.

Cases for binding the half-year's numbers are now ready. Cloth, gilt lettered, price 2*s.*, by post 2*s.* 3*d.*

To be obtained on application to the Manager, accompanied by remittance.

TO SUBSCRIBERS.

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(Taken daily at 8.30 a.m. by Steward's Instruments.)

THE LANCET Office, Jan. 1st, 1903.

Date	Barometer reduced to Sea Level and 32° F.	Direction of Wind.	Rainfall.	Solar Radia in Vacuo.	Maximum Temp. Shade.	Min. Temp	Wet Bulb.	Dry Bulb.	Remarks at 8.30 A.M.
Dec. 26	30·15	W.	...	59	51	46	45	48	Cloudy
,, 27	30·15	W.	...	71	54	47	46	49	Cloudy
,, 28	29·77	W.	0·04	63	51	46	45	46	Cloudy
,, 29	29·10	S.W.	0·21	59	43	36	37	38	Cloudy
,, 30	28·93	S.W.	...	63	43	36	35	37	Hazy
,, 31	29·15	S.W.	0·13	50	43	35	38	39	Overcast
Jan. 1	29·60	S.W.	0·01	41	39	33	33	34	Foggy

During the week marked copies of the following newspapers have been received:—*Times of India, Aberdeen Weekly Free Press, Lancashire Post, Oldham Daily Standard, Daily Mail, South Wales Echo, Westminster Gazette, Pioneer Mail (India), Devon and Exeter Express, Burnley Express, Dublin Evening Telegraph, Echo, Bradford Observer, Daily Express, Globe, Trade Protection Journal, Ross Gazette, Glasgow Herald, Lambeth Mercury, Lincoln Herald, Windsor and Eton Express, Derbyshire Courier, Manchester Weekly Chronicle, Derbyshire Times, Yorkshire Mercury, Reading Mercury, Herts Advertiser &c.*

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